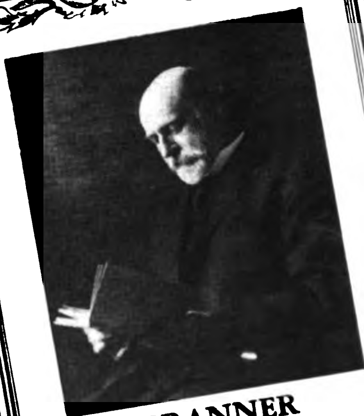

DEPARTMENT OF THE INTERIOR
JOHN BARTON PAYNE, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

WATER-SUPPLY PAPER 453

SURFACE WATER SUPPLY OF THE UNITED STATES

1917

PART III. OHIO RIVER BASIN

NATHAN C. GROVER, Chief Hydraulic Engineer
ALBERT H. HORTON and WARREN E. HALL, District Engineers

Prepared in cooperation with
THE STATES OF ILLINOIS AND KENTUCKY

WASHINGTON
GOVERNMENT PRINTING OFFICE
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CONTENTS.

ILLUSTRATIONS.

SURFACE WATER SUPPLY OF OHIO RIVER BASIN. 1917.

AUTHORIZATION AND SCOPE OF WORK.

This volume is one of a series of 14 reports presenting results of measurements of flow made on streams in the United States during the year ending September 30, 1917.

The data presented in these reports were collected by the United States Geological Survey under the following authority contained in the organic law (20 Stat. L., p. 394):

Provided, That this officer [the Director] shall have the direction of the Geological Survey and the classification of public lands and examination of the geological structure, mineral resources, and products of the national domain.

The work was begun in 1888 in connection with special studies relating to irrigation in the arid West. Since the fiscal year ending June 30, 1895, successive sundry civil bills passed by Congress have carried the following item and appropriations:

For gaging the streams and determining the water supply of the United States, and for the investigation of underground currents and artesian wells, and for the preparation of reports upon the best methods of utilizing the water resources.

Annual appropriations for the fiscal years ended June 30, 1895–1918.

1895	$12,500
1896	20,000
1897 to 1900, inclusive	50,000
1901 to 1902, inclusive	100,000
1903 to 1906, inclusive	200,000
1907	150,000
1908 to 1910, inclusive	100,000
1911 to 1917, inclusive	150,000
1918	175,000

In the execution of the work many private and State organizations have cooperated either by furnishing data or by assisting in collecting data. Acknowledgments for cooperation of the first kind are made in connection with the description of each station affected; cooperation of the second kind is acknowledged on page 11.

Measurements of stream flow have been made at about 4,240 points in the United States and also at many points in Alaska and the Hawaiian Islands. In July, 1917, 1,180 gaging stations were being maintained by the Survey and the cooperating organizations.

Many miscellaneous discharge measurements are made at other points. In connection with this work data were also collected in regard to precipitation, evaporation, storage reservoirs, river profiles, and water power in many sections of the country and will be made available in water-supply papers from time to time. Information in regard to publications relating to water resources is presented in the appendix to this report.

DEFINITION OF TERMS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups—(1) those that represent a rate of flow, as second-feet, gallons per minute, miners' inches, and discharge in second-feet per square mile, and (2) those that represent the actual quantity of water, as run-off in depth of inches, acre-feet, and millions of cubic feet. The principal terms used in this series of reports are second-feet, second-feet per square mile, run-off in inches, and acre-feet. They may be defined as follows:

"Second-feet" is an abbreviation for "cubic feet per second." A second-foot is the rate of discharge of water flowing in a channel of rectangular cross section 1 foot wide and 1 foot deep at an average velocity of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off (depth in inches)" is the depth to which an area would be covered if all the water flowing from it in a given period were uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth of inches.

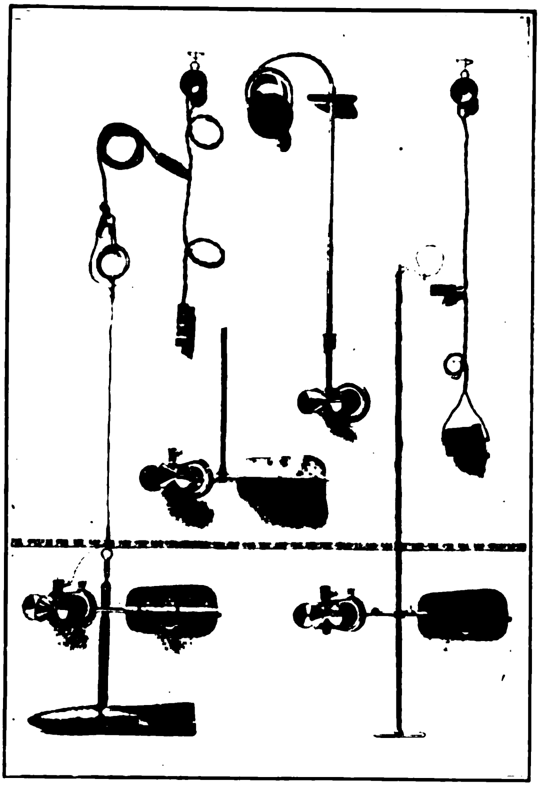
An "acre-foot," equivalent to 43,560 cubic feet, is the quantity required to cover an acre to the depth of 1 foot. The term is commonly used in connection with storage for irrigation.

The following terms not in common use are here defined:

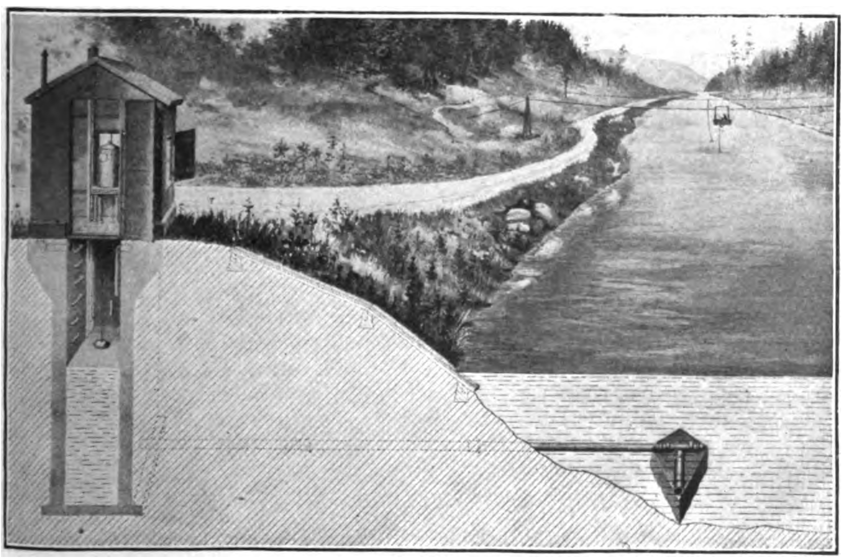
"Stage-discharge relation," an abbreviation for the term "relation of gage height to discharge."

"Control," a term used to designate the section or sections of the stream below the gage which determines the stage-discharge relation at the gage. It should be noted that the control may not be the same section or sections at all stages.

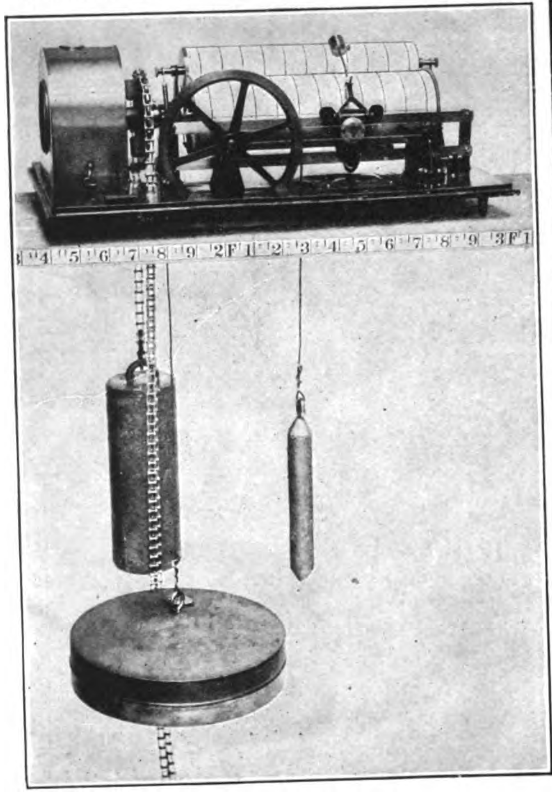
The "point of zero flow" for a gaging station is that point on the gage—the gage height—to which the surface of the river would fall if there were no flow.



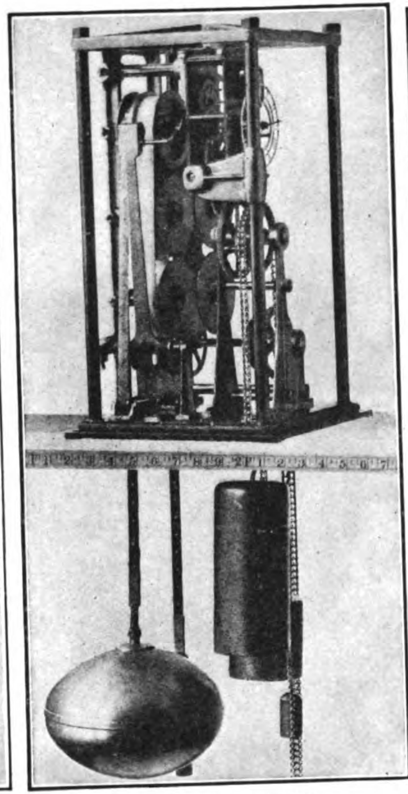
A. PRICE CURRENT METERS.



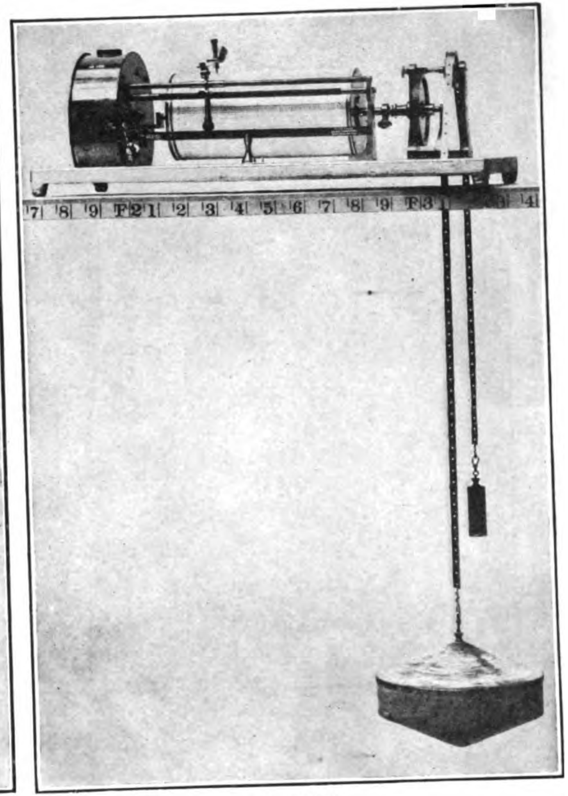
B. TYPICAL GAGING STATION.



A. STEVENS CONTINUOUS.



B. GURLEY PRINTING.



C. FRIEZ.

WATER-STAGE RECORDERS.

EXPLANATION OF DATA.

The data presented in this report cover the year beginning October 1, 1916, and ending September 30, 1917. At the beginning of January in most parts of the United States much of the precipitation in the preceding three months is stored as ground water in the form of snow or ice, or in ponds, lakes, and swamps, and this stored water passes off in the streams during the spring break-up. At the end of September, on the other hand, the only stored water available for run-off is possibly a small quantity in the ground; therefore the run-off for the year beginning October 1 is practically all derived from precipitation within that year.

The base data collected at gaging stations consist of records of stage, measurements of discharge, and general information used to supplement the gage heights and discharge measurements in determining the daily flow. The records of stage are obtained either from direct readings on a staff gage or from a water-stage recorder that gives a continuous record of the fluctuations. Measurements of discharge are made with a current meter. (See Pls. I, II.) The general methods are outlined in standard textbooks on the measurement of river discharge.

From the discharge measurements rating tables are prepared that give the discharge for any stage, and these rating tables, when applied to gage heights, give the discharge from which the daily, monthly, and yearly mean discharge is determined.

The data presented for each gaging station in the area covered by this report comprise a description of the station, a table giving results of discharge measurements, a table showing the daily discharge of the stream, and a table of monthly and yearly discharge and run-off.

If the base data are insufficient to determine the daily discharge, tables giving daily gage heights and results of discharge measurements are published.

The description of the station gives, in addition to statements regarding location and equipment, information in regard to any conditions that may affect the constancy of the stage-discharge relation, covering such subjects as the occurrence of ice, the use of the stream for log driving, shifting of control, and the cause and effect of backwater; it gives also information as to diversions that decrease the flow at the gage, artificial regulation, maximum and minimum recorded stages, and the accuracy of the records.

The table of daily discharge gives, in general, the discharge in second-feet corresponding to the mean of the gage heights read each day. At stations on streams subject to sudden or rapid diurnal fluctuation the discharge obtained from the rating table and the mean daily gage height may not be the true mean discharge for the day. If such stations are equipped with water-stage recorders the mean daily discharge may be obtained by averaging discharge at regular intervals during the day, or by using the discharge integrator, an instrument operating on the principle of the planimeter and containing as an essential element the rating curve of the station.

In the table of monthly discharge the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest. As the gage height is the mean for the day it does not indicate correctly the stage when the water surface was at crest height, and the corresponding discharge was consequently larger than given in the maximum column. Likewise, in the column headed "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow in cubic feet for each second during the month. On this average flow computations recorded in the remaining columns, which are defined on page 8, are based.

ACCURACY OF FIELD DATA AND COMPUTED RESULTS.

The accuracy of stream-flow data depends primarily (1) on the permanence of the discharge relation and (2) on the accuracy of observation of stage, measurements of flow, and interpretation of records.

A paragraph in the description of the station or footnotes added to the tables gives information regarding the (1) permanence of the stage-discharge relation, (2) precision with which the discharge rating curve is defined, (3) refinement of gage readings, (4) frequency of gage readings, and (5) methods of applying daily gage heights to the rating table to obtain the daily discharge.[1]

For the rating tables "well defined" indicates, in general, that the rating is probably accurate within 5 per cent; "fairly well defined," within 10 per cent; "poorly defined," within 15 to 25 per cent. These notes are very general and are based on the plotting of the individual measurements with reference to the mean rating curve.

The monthly means for any station may represent with high accuracy the quantity of water flowing past the gage, but the figures showing discharge per square mile and depth of run-off in inches may be subject to gross errors caused by the inclusion of large noncontributing districts in the measured drainage area, by lack of information concerning water diverted for irrigation or other use, or by inability to interpret the effect of artificial regulation of the flow of the river above the station. "Second-feet per square mile" and "Run-off (depth in inches)" are therefore not computed if such errors appear probable. The computations are also omitted for stations on streams draining areas in which the annual rainfall is less than 20 inches. All figures representing "second-feet per square mile" and

[1] For a more detailed discussion of the accuracy of stream-flow data see Grover, N. C., and Hoyt, J. C. Accuracy of stream-flow data: U. S. Geol. Survey Water-Supply Paper 400, pp. 53-59, 1916.

"run-off (depth in inches)" previously published by the Survey should be used with caution because of possible inherent sources of error not known to the Survey.

The table of monthly discharge gives only a general idea of the flow at the station and should not be used for other than preliminary estimates; the tables of daily discharge allow more detailed studies of the variation in flow. It should be borne in mind, however, that the observations in each succeeding year may be expected to throw new light on data previously published.

COOPERATION.

Work in Illinois during the year ending September 30, 1917, was carried on in cooperation with the State of Illinois Rivers and Lakes Commission.

Work in Kentucky was done in cooperation with the State Geological Survey, J. B. Hoeing, State geologist.

The United States Engineer Corps cooperated in the maintenance of 9 gaging stations in the Ohio River basin and furnished base data for 30 additional stations.

Financial assistance was also rendered by the Alabama Geological Survey and The Tennessee Power Co.

DIVISION OF WORK.

Data for Allegheny River at Red House, N. Y., were collected and prepared for publication under the direction of C. C. Covert, district engineer, assisted by O. W. Hartwell and E. D. Burchard.

Data for the Ohio River basin, except those for the Allegheny at Red House, N. Y., for stations in Illinois, and for the basin of Tennessee River, were collected and prepared for publication under the direction of A. H. Horton, district engineer, assisted by B. E. Jones, B. J. Peterson, and B. L. Hopkins.

Data for stations in Illinois in Ohio basin were collected and prepared for publication under direction of W. G. Hoyt, district engineer, assisted by H. C. Beckman.

Field data for stations in the Tennessee River basin were collected under the direction of Warren E. Hall, district engineer, assisted by L. J. Hall. The records were prepared for publication under the direction of C. G. Paulsen, district engineer, assisted by B. J. Peterson and B. L. Hopkins.

The records were assembled and reviewed by A. H. Horton, B. E. Jones, and B. J. Peterson, and B. L. Hopkins.

GAGING-STATION RECORDS.

ALLEGHENY RIVER BASIN.

ALLEGHENY RIVER AT RED HOUSE, N. Y.

Location.—At highway bridge in Red House, Cattaraugus County, 5 miles below Salamanca and 13 miles above boundary between New York and Pennsylvania. Conewango Creek, the outlet of Chautauqua Lake, enters the Allegheny in Pennsylvania about 30 miles below the station.

Drainage area.—1,640 square miles.

Records available.—September 4, 1903, to September 30, 1917.

Gage.—Gurley seven-day water-stage recorder on left bank just below highway bridge; installed September 3, 1917; prior to this date, chain gage attached to upstream side of bridge near left end. Gage read and recorder inspected by W. E. Coe.

Discharge measurements.—Made from downstream side of bridge.

Channel and control.—Coarse gravel; shifting occasionally.

Extremes of discharge.—Maximum stage recorded during year, 9.35 feet at 3 p. m. March 12 (discharge, 17,600 second-feet); minimum stage recorded, 3.15 feet October 6, 11, and 12 (discharge, 238 second-feet).

1903–1917: Maximum stage recorded, 12.7 feet March 26, 1913 (discharge, about 40,000 second-feet); minimum stage recorded, 2.7 feet on several days in December, 1908 (discharge about 100 second-feet).

Ice.—Stage-discharge relation somewhat affected by ice.

Regulation.—Low-water flow may be slightly affected by the operation of several small power plants above Salamanca. A storage reservoir on the divide between Oil Creek, tributary to Allegheny River, and Genesee River, tributary to Lake Ontario, was formerly used for supplying water to the Erie Canal system through the abandoned Genesee River Canal and Genesee River. The reservoir is no longer used for canal purposes, and the water is all turned into Allegheny River through Olean Creek.

Accuracy.—Stage-discharge relation practically permanent between dates of shifting; affected by ice during most of February. Rating curve well defined between 300 and 900 second-feet and between 6,000 and 13,000 second-feet. Gage read to half tenths twice daily. Operation of water-stage recorder satisfactory September 3–14 and 29–30; daily gage height for this period determined by inspecting recorder graph. Daily discharge ascertained by applying mean daily gage height to rating table. Open-water records good; others fair.

Discharge measurements of Allegheny River at Red House, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec-ft.*			*Feet.*	*Sec.-ft.*
Oct. 25	E. D. Burchard	3.70	695	May 30	E. D. Burchard	7.02	8,130
25	.....do	3.70	707	June 26	.....do	4.81	2,470
Feb. 9[a]	.....do	6.92	883	26	.....do	4.78	2,410
Mar. 13	.....do	8.56	13,500	July 30	C. C. Covert	5.00	2,710
13	.....do	8.20	12,200	Aug. 20	J. W. Moulton	4.24	1,470
29	C. C. Covert	7.80	10,500	30	E. D. Burchard	3.57	634

[a] Measurement made through complete ice cover.

Daily discharge, in second-feet, of Allegheny River at Red House, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	278	368	6,600	1,730	2,000	8,250	7,730	1,890	8,060	3,610	1,890	1,010
2	278	495	6,600	1,730	1,700	6,000	7,400	1,890	7,400	7,080	1,570	1,570
3	278	595	5,410	1,730	1,500	4,090	7,400	2,230	7,400	8,060	1,140	2,040
4	265	545	4,090	1,730	1,400	3,850	7,080	2,060	6,170	6,770	890	1,620
5	265	423	2,980	2,400	1,200	3,850	7,400	2,230	4,300	5,060	775	1,240
6	254	423	2,050	6,600	1,100	3,850	7,400	2,410	4,550	3,610	665	1,010
7	265	405	1,580	7,550	1,000	3,850	7,730	3,610	8,750	3,180	665	902
8	265	423	1,580	4,860	950	3,850	6,470	4,800	12,800	4,300	665	832
9	278	595	1,730	3,850	900	2,590	5,600	4,550	13,200	4,060	665	775
10	265	810	1,440	3,620	850	1,810	4,800	4,550	10,800	4,060	665	698
11	238	990	1,300	2,500	800	3,850	4,800	4,300	11,200	3,830	665	625
12	238	930	1,170	1,890	800	15,000	4,550	4,550	10,200	7,400	775	585
13	345	930	1,110	1,730	750	14,100	4,300	4,060	7,730	7,080	665	546
14	648	1,050	1,110	1,580	700	10,800	4,060	3,830	6,770	6,170	720	498
15	545	1,050	990	1,580	700	9,800	3,390	3,390	5,060	5,060	1,010	....
16	477	1,050	930	1,580	700	10,200	2,780	2,780	3,610	4,800	2,980	....
17	423	1,110	850	1,730	700	7,730	2,410	2,060	2,590	4,060	2,780	....
18	423	1,110	800	1,580	800	5,880	2,410	1,890	2,320	3,830	2,060	....
19	545	1,170	800	1,510	950	5,060	2,230	1,890	2,060	3,180	1,730	....
20	1,170	1,050	750	1,440	950	6,170	2,060	2,590	1,570	3,180	1,570	....
21	1,970	1,050	700	1,440	900	7,400	2,140	4,060	1,420	2,980	1,140	....
22	1,170	930	700	1,730	950	6,470	2,230	4,060	1,280	2,320	1,140	....
23	1,170	930	700	2,220	900	6,170	2,060	4,060	1,280	2,410	1,280	....
24	930	2,310	700	2,140	950	8,060	1,980	4,060	3,180	2,060	1,210	....
25	755	3,400	750	2,050	1,200	9,450	2,060	4,060	4,060	1,890	1,010	....
26	595	2,590	800	1,890	7,550	8,750	2,060	4,060	4,300	1,890	950	....
27	545	2,050	1,000	1,890	12,400	9,800	2,060	4,300	2,980	2,140	775	....
28	495	2,590	1,440	1,730	10,800	10,800	2,060	6,170	2,780	2,060	615	....
29	423	4,860	2,400	1,440	....	11,600	2,060	8,750	2,780	2,410	665	298
30	330	6,300	2,400	1,580	....	10,200	1,980	8,750	2,780	2,780	720	304
31	390	....	1,810	2,220	....	7,080	....	7,400	....	2,320	890	....

NOTE.—Discharge, Dec. 17-27 and Feb. 2-25, estimated because of ice, from discharge measurements, weather records, study of gage-height graph and comparison with similar studies for stations on adjacent streams. Mean discharge Sept. 15-28, estimated 407 second-feet.

Monthly discharge of Allegheny River at Red House, N. Y., for the year ending Sept 30, 1917.

[Drainage area, 1,640 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,970	238	533	0.325	0.37
November	6,300	368	1,420	.866	.97
December	6,600	700	1,850	1.13	1.30
January	7,550	1,440	2,360	1.44	1.66
February	12,400	700	2,000	1.22	1.27
March	15,000	1,810	7,300	4.45	5.13
April	7,730	1,980	4,090	2.49	2.78
May	4,800	1,890	3,910	2.38	2.74
June	13,200	1,280	5,450	3.32	3.70
July	8,060	1,890	3,990	2.43	2.80
August	2,980	615	1,130	.690	.80
September	2,060	370	675	.412	.46
The year	15,000	238	2,900	1.77	23.98

MONONGAHELA RIVER BASIN.

TYGART RIVER NEAR DAILEY, W. VA.

LOCATION.—At Burnt Bridge, on Staunton-Parkersburg pike 1 mile northeast of Dailey, Randolph County, 2 miles south of Beverly, on Western Maryland Railroad. Stalnaker Run enters river on right about 1,000 feet below station and above control.

DRAINAGE AREA.—194 square miles (measured on topographic maps).

RECORDS AVAILABLE.—April 20, 1915, to September 30, 1917.

GAGE.—Vertical staff on face of right abutment of bridge near downstream end; read by Charles W. Chenoweth.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading. Stay wire is used for measurements at high stages. Flow of Stalnaker Run is included.

CHANNEL AND CONTROL.—One channel at all stages, straight for 100 feet above and 1,300 feet below bridge. Right bank high; left bank low; large overflow through meadows at high stages. Stream bed is rocky, but banks are sandy. Control probably permanent. Point of zero flow, September 26, 1917, at gage height, 0.2 foot $\pm$ 0.1 foot.

EXTREMES OF STAGE.—Maximum stage recorded during year, 13.4 feet at 7 a. m., March 12; minimum stage, 0.6 foot at 7 a. m., September 6, 1916. Highest known flood reached a stage represented by gage height about 16 feet.

ICE.—Stage-discharge relation affected by ice at times.

ACCURACY.—Stage-discharge relation probably permanent; affected by ice during December, January, and February. Rating curve not yet developed. Gage read twice daily to half-tenths. Records good.

COOPERATION.—Station maintained in cooperation with United States Engineer Corps.

Discharge measurements of Tygart River near Dailey, W. Va., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Apr. 6	B. E. Jones	3.47	702
8	....do	4.42	1,120
Sept. 26	Peterson and Hopkins	.75	10.2

Daily gage height, in feet, of Tygart River near Dailey, W. Va., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.35	1.30	1.62	2.70	3.29	4.78	2.00	2.54	2.82	1.98	1.18	0.63
2	1.98	1.30	1.58	2.46	3.66	3.77	1.99	2.28	2.85	1.46	1.10	.63
3	1.72	1.24	1.50	2.82	3.40	5.84	1.96	2.10	2.82	1.34	1.07	.63
4	1.55	1.16	1.46	3.76	3.36	6.92	1.80	2.00	2.48	1.28	1.06	.63
5	1.45	1.14	1.56	4.34	3.20	5.92	1.85	1.98	2.23	1.18	1.05	.63
6	1.32	1.10	1.68	7.74	3.20	4.20	2.70	1.80	2.12	1.10	1.02	1.05
7	1.28	1.10	1.58	4.36	....	3.82	3.35	1.75	1.94	1.04	1.00	1.06
8	1.22	1.08	1.65	3.62	....	7.90	5.18	1.81	1.79	.99	1.03	1.60
9	1.30	1.06	1.59	2.82	....	5.31	3.62	2.75	1.72	.96	1.04	2.40
10	1.58	1.14	1.58	2.48	3.20	4.04	3.15	3.03	1.98	.95	.96	1.65
11	1.42	1.12	1.52	2.24	3.20	5.52	3.40	2.70	2.05	.90	.92	1.39
12	1.32	1.10	1.58	2.09	....	13.00	3.80	2.48	1.78	.90	.86	1.18
13	1.25	1.08	1.60	2.20	....	7.70	3.40	2.29	1.62	.90	.85	1.05
14	1.22	1.10	1.66	2.82	....	9.48	2.91	2.12	1.54	.90	.85	.97
15	1.20	1.08	1.70	3.24	....	4.71	2.60	2.08	1.50	.90	.85	.90
16	1.20	1.00	1.70	3.10	....	3.95	2.27	1.91	1.44	1.00	.82	.88
17	1.40	1.00	1.70	2.55	3.20	3.88	2.05	1.80	1.38	1.12	.82	.82
18	2.18	1.00	1.70	2.38	3.20	4.05	2.00	1.76	1.29	1.55	.74	.80
19	2.05	1.00	1.70	2.18	....	3.29	1.92	1.72	1.24	1.85	.70	.76
20	2.52	1.00	1.70	1.95	5.55	3.18	1.84	1.67	1.26	1.45	.67	.74
21	2.85	1.00	1.82	3.97	4.62	3.70	1.76	1.64	1.22	1.36	.65	.74
22	2.28	1.00	5.31	10.60	3.38	5.72	1.72	1.57	1.14	1.40	.64	1.52
23	1.92	1.02	4.09	5.06	3.02	3.97	1.64	1.52	1.08	2.08	.62	.94
24	1.74	2.06	2.87	3.48	9.14	4.99	1.60	1.48	1.30	2.05	.68	.81
25	1.61	2.28	2.50	2.86	5.04	4.40	1.60	1.40	1.05	2.92	.72	.78
26	1.52	1.80	2.26	2.45	3.66	3.30	1.60	1.36	1.02	2.32	.75	.75
27	1.51	1.76	2.82	1.75	4.43	2.81	1.58	8.32	1.00	1.96	.71	.75
28	1.51	1.82	6.98	2.19	5.42	2.60	1.59	8.02	1.08	1.67	.65	.75
29	1.51	1.68	5.65	2.20	....	2.44	2.79	9.12	2.02	1.56	.64	.78
30	1.29	1.62	3.88	2.68	....	2.26	2.70	5.20	2.32	1.42	.64	.80
31	1.26	....	2.86	2.60	....	2.10	....	3.52	....	1.34	.63	....

NOTE.—No gage readings Feb. 7-9, 12-16, and 19. Gage read to top of ice Dec. 14-21, Jan. 15, Feb. 3, 5, 10, 11, 17, 18.

TYGART RIVER AT BELINGTON, W. VA.

LOCATION.—At highway bridge at Belington, Barbour County, one-fourth mile above mouth of Mill Creek.

DRAINAGE AREA.—390 square miles.

RECORDS AVAILABLE.—June 5, 1907, to September 30, 1917.

GAGE.—Chain gage attached to the upstream side of highway bridge to left of center of the river; read by S. A. Campbell. Sea-level elevation of zero of gage, 1,679.89 feet.

DISCHARGE MEASUREMENTS.—Made from upstream side of the bridge.

CHANNEL AND CONTROL.—Practically permanent; straight above and below.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 21.48 feet at 7.30 a. m., March 13 (discharge about 20,000 second-feet); minimum stage, 2.01 feet at 7 a. m., August 29 and September 30 (discharge 14 second-feet).

ICE.—Ice may affect stage-discharge relation for short periods during December, January, and February.

ACCURACY.—Stage-discharge relation practically permanent; apparently little affected by ice during 1917. Daily discharge determined from rating curve well defined between 300 and 4,000 second-feet, fairly well defined between 13 and 300 second-feet; beyond these limits curve is extension. Gage read daily in the morning to hundredths. Daily discharge ascertained by applying mean daily gage heights to rating table. Open-water rating curve used to determine winter discharge, as effect of ice on stage-discharge relation was considered small.

The following discharge measurement was made by Peterson and Hopkins: September 22, 1917—Gage height, 2.16 feet; discharge, 23.8 second-feet.

Daily discharge, in second-feet, of Tygart River at Belington, W. Va., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	233	79	252	700	1,000	3,370	540	1,000	1,340	205	69	212
2	395	53	212	672	1,340	2,110	440	700	1,130	202	48	38
3	233	53	176	1,830	1,000	2,110	372	515	940	185	72	67
4	169	75	169	2,920	1,000	2,270	350	440	820	110	97	69
5	138	52	226	1,900	760	4,630	230	1,830	565	104	101	39
6	79	30	540	3,640	418	3,010	1,760	760	465	69	82	24
7	93	77	395	3,190	540	1,970	1,480	310	395	43	35	31
8	18	51	310	1,690	540	6,800	1,760	270	330	222	34	310
9	40	56	233	1,060	490	6,690	2,510	540	233	84	40	540
10	89	53	252	820	350	2,830	1,480	1,200	216	69	182	418
11	15	59	233	645	233	2,510	1,270	1,000	672	44	95	192
12	138	49	252	418	270	12,300	1,340	820	233	40	75	15
13	114	82	252	1,060	230	20,000	1,620	672	270	32	37	82
14	91	77	395	645	270	13,400	1,060	540	226	31	31	61
15	82	77	350	1,200	226	4,830	1,060	440	192	22	27	44
16	77	70	350	1,060	350	2,590	1,130	395	188	155	23	42
17	15	86	418	860	290	1,340	465	330	133	155	22	41
18	233	70	372	730	330	1,340	395	270	128	119	23	17
19	330	72	406	565	940	1,690	330	208	84	222	19	23
20	395	73	406	465	1,900	205	350	233	89	590	15	22
21	590	82	440	820	3,190	1,200	290	202	104	182	14	18
22	515	19	940	9,060	1,760	2,670	252	192	99	290	12	24
23	418	53	3,930	7,860	1,060	2,510	222	233	70	131	12	36
24	310	138	2,190	2,040	940	1,900	216	222	67	310	17	46
25	233	730	1,060	1,270	1,000	1,480	133	212	79	158	88	32
26	198	590	700	820	1,000	1,900	212	158	72	490	23	23
27	136	372	590	565	1,410	1,130	195	169	61	1,200	26	16
28	128	270	2,270	515	3,830	1,000	252	7,260	618	233	17	17
29	440	270	6,030	590	....	730	233	6,360	222	350	14	14
30	440	230	1,620	700	....	618	219	3,830	202	252	20	14
31	82	....	1,270	590	....	540	....	2,350	....	82	17	....

Monthly discharge of Tygart River at Belington, W. Va., for the year ending Sept. 30, 1917.

[Drainage area, 390 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	590	15	209	0.536	0.62
November	730	19	135	.346	.39
December	6,030	169	879	2.25	2.59
January	9,060	418	1,640	4.21	4.85
February	3,830	226	952	2.44	2.54
March	20,000	205	3,600	9.23	10.64
April	2,510	133	739	1.89	2.11
May	7,260	158	1,090	2.79	3.22
June	1,340	61	341	.874	.98
July	1,200	22	213	.546	.63
August	182	12	44.7	.115	.13
September	540	14	84.2	.216	.24
The year	20,000	12	831	2.13	28.96

TYGART RIVER AT FETTERMAN, W. VA.

Location.—At highway bridge at Fetterman, Taylor County, three-fourths mile above mouth of Otter Creek.

Drainage area.—1,340 square miles.

Records available.—June 3, 1907, to September 30, 1917.

Gage.—Chain gage attached to downstream side of highway bridge; read by Joseph Weaver. Sea-level elevation of zero of gage, 957.86 feet.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 21.1 feet at 7 a. m. January 22 (discharge about 36,000 second-feet); minimum stage, 3.13 feet August 24 and morning of August 25 (discharge, 54 second-feet).

No records of floods previous to installation of gage; highest stage recorded since station was established, 29.1 feet, in July, 1912.

ICE.—Ice probably affects stage-discharge relation for short periods in severe winters.

ACCURACY.—Stage-discharge relation practically permanent. Affected by ice December 17-20 and February 4–19. Rating curve well defined between 100 and 23,000 second-feet, poorly defined below 100 second-feet; above 23,000 second-feet the curve is an extension. Gage read twice daily to half-tenths. Discharge ascertained by applying mean daily gage heights to rating table. Estimates of daily discharge during periods stage-discharge relation was affected by ice are poor; the records for other periods are good.

The following discharge measurement was made by Peterson and Hopkins: September 21, 1917: Gage height, 3.26 feet; discharge, 79.4 second-feet.

Daily discharge, in second-feet, of Tygart River at Fetterman, W. Va., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,440	315	1,030	2,610	2,970	9,120	1,450	2,440	4,670	760	402	380
2	1,450	315	1,030	2,180	2,610	5,240	1,230	2,020	3,530	578	334	665
3	920	285	920	3,720	2,440	6,000	1,030	1,530	3,530	402	303	455
4	665	285	865	8,530	2,000	13,000	920	1,300	2,970	303	244	303
5	495	255	1,300	6,580	1,700	13,200	975	1,160	2,180	244	244	244
6	418	255	2,270	8,140	1,400	9,700	1,770	1,160	2,440	191	216	191
7	367	211	1,930	9,500	1,200	6,780	3,530	1,030	4,480	168	168	148
8	303	200	1,380	5,240	1,000	20,500	7,560	920	2,790	168	148	273
9	267	200	1,160	3,340	900	24,100	7,750	1,160	2,100	273	168	920
10	328	267	1,160	2,440	800	9,310	6,000	2,020	2,180	367	200	1,160
11	395	315	1,100	1,770	700	10,700	3,340	2,180	2,790	303	425	710
12	455	315	1,030	1,380	600	29,400	3,530	1,930	2,180	244	303	479
13	440	315	920	920	600	31,400	3,530	1,770	1,450	191	244	334
14	395	328	810	1,930	600	25,100	2,970	1,530	975	216	191	244
15	328	380	710	3,150	550	17,800	2,270	1,300	810	2,970	148	191
16	1,030	455	620	2,160	550	8,340	1,770	1,100	760	1,610	148	148
17	2,440	418	600	2,270	550	5,620	1,380	920	710	1,100	114	114
18	2,020	380	600	2,610	750	6,000	1,160	865	620	760	114	114
19	2,970	380	600	2,270	1,000	4,860	1,100	760	535	578	90	99
20	2,970	367	600	1,770	4,480	3,720	1,030	665	440	535	72	85
21	2,610	315	1,230	1,930	8,920	3,340	920	620	367	760	62	88
22	1,930	315	10,700	35,800	5,050	4,290	810	578	303	535	62	78
23	1,450	380	12,400	20,500	3,150	6,000	710	665	303	479	62	78
24	1,030	1,300	6,000	7,940	8,140	5,620	710	810	273	665	54	65
25	810	2,270	3,340	4,100	14,500	7,360	620	760	273	760	65	65
26	710	2,270	2,610	2,790	7,160	5,430	620	665	244	1,690	114	65
27	620	1,450	2,970	2,020	5,430	3,720	620	8,530	216	1,850	85	65
28	495	1,160	10,900	1,850	11,100	2,790	665	26,000	255	1,300	72	65
29	455	1,030	16,900	2,270	....	2,440	1,030	24,600	760	975	72	65
30	418	1,030	8,530	3,720	....	2,020	2,610	18,600	535	760	80	65
31	367	....	4,100	3,910	....	1,690	....	8,140	....	578	120	....

NOTE.—Daily discharge estimated because of ice Dec. 17-20 and Feb. 4-19.

Monthly discharge of Tygart River at Fetterman, W. Va., for the year ending Sept. 30, 1917.

[Drainage area, 1,340 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	2,970	267	1,030	0.769	0.89
November	2,270	200	592	.442	.49
December	16,900	600	3,240	2.42	2.79
January	35,800	920	5,150	3.84	4.43
February	14,500	620	3,240	2.42	2.52
March	31,400	1,690	9,830	7.34	8.46
April	7,750	620	2,120	1.58	1.76
May	26,600	578	3,820	2.85	3.29
June	4,670	216	1,520	1.13	1.26
July	2,970	168	720	.537	.62
August	425	54	165	.123	.14
September	1,160	65	265	.198	.22
The year	35,800	54	2,650	1.98	26.87

MONONGAHELA RIVER AT LOCK 15, HOULT, W. VA.

Location.—At Lock 15, at Hoult, 2½ miles below county highway bridge at Fairmont, Marion County, and 4 miles below mouth of West Fork. Buffalo Creek enters on left three-fourths mile above station.

Drainage area.—2,430 square miles (measured on topographic maps).

Records available.—April 7, 1915, to September 30, 1917. Upper and lower gages at Lock 15 have been read under direction of United States Engineer Corps since May 1, 1904.

Gage.—Upper gage at lock; lower section is set in recess in left lock wall just above upper gate; upper section is 61.5 feet from face of right lock wall, directly opposite lower section. Read by Charles R. Hall, lockmaster.

Discharge measurements.—Made from bridge at Fairmont or by wading on crest of dam. Flow of Buffalo Creek is added to discharge measured at bridge.

Channel and control.—One channel at all stages; straight half a mile above and below bridge. Control of station is crest of dam; permanent. Point of zero flow, gage height 6.9 feet, elevation of crest of dam. Leakage through lock and occasional opening of valves of lock may affect stage at which flow would be zero.

Extremes of discharge.—Maximum stage recorded during 1917, 21.0 feet at 11 a. m. January 22 (discharge, 90,300 second-feet); minimum stage, 6.60 feet at 7 p. m. August 24, 1916, due to opening the valves. Flood of 1888, before dam No. 15 was built, reached a stage represented by gage height about 26 feet.

Ice.—Stage-discharge relation affected by ice when ice in pool above dam forms close to crest of dam.

Diversions.—Leakage through lock and water used for lockages. See "Accuracy."

Regulation.—None under normal conditions. Pool No. 15 may be lowered at times in the interest of navigation.

ACCURACY.—Stage-discharge relation permanent except for effect of operations at lock and change in leakage through lock, the change depending on which gates are open; affected by ice December 17–20 and February 7–18. Rating curve well defined to 62,000 second-feet. Gage read twice daily to hundredths, beginning April 7, 1915; prior to that date, at 8 a. m. daily to tenths. Daily discharge ascertained by applying mean daily gage heights to rating table, and adding amount of water used for lockage. Rating table makes allowance based on measurement for leakage through upper gates, for under normal conditions upper gates are closed; gage reader records number of lockages and length of time upper gates are open. Daily discharge April 7, 1915, to September 30, 1917, corrected for effect of lockage and change in leakage when upper gates at lock are open. Data for correcting earlier records nor available.

Discharge August 23, 24, and 25 interpolated because valves at lock were open for considerable periods with little or no flow over the dam. Results considered good except for periods when daily discharge was estimated because of ice or interpolated because of opening valves at lock and lowering pool.

COOPERATION.—Station maintained in cooperation with United States Engineer Corps.

The following measurement of leakage through the lower gates, Lock 15, was made by Peterson and Hopkins:

October 3, 1917: Gage height, 7.10 feet; discharge, 120 second-feet. The lower gates were shut and upper gates open.

Discharge measurements of Monongahela River at Lock 15, Hoult, W. Va., during the year ending Sept. 30, 1917.

[Made by B. E. Jones.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Mar. 13	16.4	48,100	Mar. 15	13.94	29,000
Mar. 14	15.92	44,600	15	13.40	25,100

Daily discharge, in second-feet, of Monongahela River at Lock 15, Hoult, W. Va., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	3,420	497	1,780	4,180	5,520	15,000	2,140	3,630	7,870	783	649	695
2	2,020	489	1,900	3,420	4,340	11,500	1,790	2,760	7,440	728	449	1,090
3	1,280	434	1,570	5,520	3,420	8,710	1,810	2,090	6,670	505	473	815
4	915	409	1,370	15,600	2,350	18,400	1,500	1,860	5,580	422	400	614
5	684	392	1,280	11,500	1,780	20,800	1,490	1,510	3,620	315	359	424
6	557	369	2,860	14,500	1,570	16,100	6,620	1,670	4,540	279	333	330
7	442	340	3,420	14,600	1,350	11,000	14,500	1,430	10,600	253	251	287
8	394	347	2,360	8,260	1,150	35,200	13,500	1,350	7,020	236	226	305
9	362	305	1,890	5,170	1,050	43,200	10,600	1,500	4,520	265	263	622
10	364	456	1,780	4,180	1,000	20,200	6,680	2,190	6,660	460	340	1,580
11	410	564	1,690	3,000	900	17,800	5,220	2,660	7,030	540	583	1,090
12	452	508	1,570	2,230	900	38,400	4,560	2,400	5,030	339	519	671
13	533	464	1,570	1,680	850	46,500	4,560	2,150	3,280	304	358	468
14	497	457	1,280	2,600	800	41,600	3,910	1,760	2,010	306	292	380
15	444	530	1,050	5,520	800	26,600	3,190	1,640	1,500	3,870	263	304
16	512	486	830	5,000	800	12,500	2,430	1,350	1,380	5,200	225	246
17	3,720	564	800	4,020	900	9,630	1,860	1,200	1,190	2,880	193	204
18	4,020	558	800	4,020	1,100	10,600	1,750	999	930	1,690	182	208
19	5,520	551	800	3,280	2,350	8,270	1,650	792	761	1,370	160	184
20	7,820	486	800	2,230	4,340	5,910	1,550	672	583	1,480	148	172
21	5,890	478	1,370	2,470	7,820	5,010	1,340	676	538	1,400	114	140
22	3,720	464	18,400	80,800	6,620	5,180	1,150	631	468	1,030	105	141
23	2,620	464	20,800	35,200	4,660	7,820	1,010	714	428	1,100	110	113
24	1,780	2,000	10,100	12,500	11,500	9,640	920	971	382	914	113	120
25	1,370	4,180	5,520	6,280	20,200	11,500	845	953	321	1,030	116	100
26	1,050	3,870	4,020	4,700	11,000	8,720	945	820	336	1,460	119	118
27	866	2,600	7,000	3,200	7,820	5,530	967	8,260	268	3,220	137	77
28	734	1,890	19,600	3,190	15,600	4,500	1,050	48,200	243	2,670	142	162
29	653	1,570	28,000	4,850	....	3,760	1,600	40,800	692	2,010	140	133
30	560	1,580	13,500	8,280	....	3,000	2,790	27,300	945	1,450	154	110
31	513	....	6,250	7,000	....	2,480	....	12,000	....	855	157	....

NOTE.—Daily discharge estimated because of ice Dec. 17–20, Feb. 7–18.

Monthly discharge of Monongahela River at Lock 15, Hoult, W. Va., for the year ending Sept. 30, 1917.

[Drainage area, 2,430 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	7,820	362	1,750	0.720	0.83
November	4,180	305	943	.388	.43
December	28,000		5,350	2.20	2.54
January	80,800	1,680	9,300	3.83	4.42
February	20,200		4,370	1.80	1.87
March	46,500	2,480	15,600	6.42	7.40
April	14,500	845	3,460	1.42	1.58
May	48,200	631	5,710	2.35	2.71
June	10,600	243	3,090	1.27	1.42
July	5,200	236	1,270	.523	.60
August	649	105	260	.107	.12
September	1,580	77	397	.163	.18
The year	80,800	77	4,320	1.78	24.10

MIDDLE FORK AT MIDVALE, W. VA.

Location.—About one-third mile above Midvale railroad station on Coal & Coke Railroad, two-thirds mile below post office at Ellamore, Randolph County. Laurel Creek enters river on right about 1¾ miles above station.

Drainage area.—122 square miles (measured on topographic maps).

Records available.—May 3, 1915, to September 30, 1917.

Gage.—Vertical and inclined staff on right bank; read by Anna Riley.

Discharge measurements.—Made from cable or by wading short distance below gage.

Channel and control.—One channel at all stages; straight 300 feet above and 100 feet below cable section. Both banks are high and in most places wooded. Control probably permanent.

Extremes of discharge.—Maximum stage recorded during year, 10.67 feet at 7 a. m. March 12, 1917 (discharge, about 4,590 second-feet); minimum stage, 1.12 feet at 7 a. m. August 29, 1917 (discharge, 2.6 second-feet). Floods of 1888 and 1912 reached gage height of about 18 feet.

Ice.—Stage-discharge relation affected by ice for short periods in severe winters.

Accuracy.—Stage-discharge relation practically permanent; affected by ice to slight extent December 19–21, January 12–15, and considerably February 2–17. Rating curve well defined below 1,600 second-feet; above this point, curve is an extension. Gage read twice daily to hundredths. Discharge ascertained by applying mean daily gage heights to rating table. Daily discharge for periods in December and January affected by ice are probably in error to a small extent. Estimated mean flow February 2–17 may be considerably in error; records for rest year are excellent.

Cooperation.—Station maintained in cooperation with United States Engineer Corps.

The following discharge measurements were made during the year by B. E. Jones and by Peterson and Hopkins, respectively:

April 7, 1917: Gage height, 2.97 feet; discharge, 261 second-feet.

September 27, 1917: Gage height, 1.22 feet; discharge, 5.1 second-feet.

Daily discharge, in second-feet, of Middle Fork at Midvale, W. Va., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	138	44	112	322	410	784	178	308	474	36	25	10
2	104	36	101	220	365	474	168	282	442	25	23	11
3	71	34	94	474		1,020	158	138	322	20	18	8.2
4	57	33	92	658		1,460	120	168	158	16	15	7.4
5	46	31	158	698		1,290	129	168	198	14	13	5.8
6	40	32	220	1,510		784	268	129	188	13	11	5.8
7	35	27	178	828		618	294	120	198	14	9	38
8	34	28	158	380		2,960	658	138	168	30	35	178
9	38	28	148	365		1,630	544	380	148	21	21	120
10	86	38	120	268	290	828	474	294	148	20	31	62
11	67	44	120	178		2,250	658	281	148	20	27	42
12	55	36	120	158		4,000	658	244	112	18	20	30
13	50	39	104	198		2,380	580	188	92	17	13	20
14	49	43	95	508		2,380	380	178	83	14	12	18
15	46	46	98	580		1,290	294	158	89	18	10	17
16	61	49	112	544		740	220	138	81	70	9	11
17	96	46	112	442		658	178	120	65	54	9	10
18	104	49	112	350	442	580	168	104	57	44	8.2	8.2
19	148	48	112	220	658	474	148	98	47	44	6.6	6.6
20	256	46	112	138	1,760	380	129	89	60	36	5.0	6.6
21	158	42	256	1,510	874	508	120	89	52	40	3.8	6.6
22	129	40	1,340	3,740	544	922	112	78	42	158	3.5	10
23	104	48	698	1,180	442	698	94	138	36	104	4.1	22
24	86	268	410	740	2,070	740	95	120	33	88	5.0	13
25	74	268	322	410	1,120	740	86	92	33	72	9.6	9
26	67	198	256	308	658	410	86	83	28	112	6.2	7.8
27	58	158	268	148	1,240	410	81	3,020	25	94	4.4	6.6
28	48	120	2,000	232	1,120	336	104	2,250	46	75	3.2	7.4
29	46	112	1,070	268	......	294	178	2,830	42	50	2.6	14
30	44	120	618	380	......	244	410	1,400	46	36	3.2	13
31	40	......	365	336	......	209	......	698	......	33	5.8	......

NOTE.—Daily discharge Feb. 3-17 estimated because of ice from study of climatic data, gage readings, and gage observer's notes. Braced figures show mean discharge for period included.

Monthly discharge of Middle Fork at Midvale, W. Va., for the year ending Sept. 30, 1917.

[Drainage area, 122 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	256	34	78.5	0.643	0.74
November	268	27	71.7	.588	.66
December	2,000	92	325	2.66	3.07
January	3,740	138	590	4.84	5.58
February	2,070	....	573	4.70	4.89
March	4,000	209	1,050	8.61	9.93
April	658	81	259	2.12	2.36
May	3,020	78	467	3.83	4.42
June	474	25	122	1.00	1.12
July	158	13	45.4	.372	.43
August	35	2.6	12.0	.098	.11
September	178	5.8	24.2	.198	.22
The year	4,000	2.6	301	2.47	33.53

BUCKHANNON RIVER AT HALL, W. VA.

Location.—About 500 feet below ruins of an old milldam, one-fourth mile above post office and county highway bridge at Hall, Barbour County, 1 mile from Baltimore & Ohio Railroad station. Pecks Run enters river on left 1 mile below station.

Drainage area.—277 square miles (measured on topographic maps).

Records available.—April 15, 1915, to September 30, 1917. June 7, 1907, to May 25, 1909, chain gage at county highway bridge.

Gage.—Vertical and inclined staff on right bank; read by James Newcomb.

Discharge measurements.—Made from county highway bridge. Stay wire used for measurements at high stages.

Channel and control.—Gage is about midway between beginning and end of rapids, having approximately 10 feet fall. Bed of stream in rapids composed of boulders, rocks, and gravel; should be fairly permanent. Both banks are high and wooded and are not overflowed except into an old mill race on left bank.

Extremes of discharge.—Maximum stage recorded during year, 11.70 feet at 5 p. m. March 12, 1917 (discharge, 9,630 second-feet); minimum stage, 1.70 feet at 6 a. m. September 27, 1917 (discharge, 8.5 second-feet).

Highest flood known reported to have reached a gage height of about 14 feet in 1888.

Ice.—Stage-discharge relation affected by ice during severe winters.

Diversions.—No water diverted above station except small quantity which may flow around gage in abandoned mill race above ordinary low stages and which is included in flow measured at county highway bridge.

Accuracy.—Stage-discharge relation practically permanent; affected by ice February 4–15. Rating curve well defined between 40 and 4,500 second-feet; extended beyond these limits. Gage read twice daily to hundredths. Daily discharge ascertained by applying mean daily gage heights to rating table. Record excellent except for period February 4–15, for which daily discharge was estimated because of ice.

Cooperation.—Station maintained in cooperation with United States Engineer Corps.

The following discharge measurement was made by Peterson and Hopkins:
September 28, 1917: Gage height, 1.77 feet; discharge, 11.7 second-feet.

Daily discharge, in second-feet, of Buckhannon River at Hall, W. Va., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	770	104	403	675	675	2,180	403	426	970	98	138	69
2	450	101	338	580	770	1,500	352	367	1,020	88	104	104
3	297	93	297	970	490	1,840	311	297	1,170	69	78	61
4	218	88	265	2,180	460	3,500	277	265	820	50	65	53
5	175	83	490	1,500	430	3,400	249	260	580	37	51	40
6	124	73	920	2,620	400	2,180	474	265	474	34	40	29
7	104	71	580	2,190	370	1,610	1,020	228	450	26	69	50
8	98	63	450	1,220	340	6,000	2,180	218	403	37	93	180
9	88	69	403	770	270	6,220	1,440	284	338	26	78	338
10	114	73	396	675	220	2,620	1,020	418	490	19	71	213
11	204	88	331	490	160	1,960	870	410	535	53	83	114
12	180	104	311	381	130	8,640	920	403	410	55	57	78
13	138	93	311	304	120	8,420	920	352	304	51	45	55
14	117	93	297	675	120	5,580	770	318	213	40	36	43
15	111	101	208	1,070	120	3,500	580	284	208	63	36	43
16	150	117	166	920	138	1,610	458	249	218	270	31	37
17	374	117	170	770	208	1,390	374	213	180	244	23	26
18	403	117	218	628	396	1,500	331	189	138	244	22	22
19	535	101	338	490	722	1,120	297	175	124	442	22	24
20	675	98	270	426	1,170	870	265	158	96	284	19	26
21	535	96	628	628	1,960	770	228	142	83	194	15	19
22	450	96	3,220	7,540	1,170	1,390	204	166	73	134	12	13
23	338	98	3,220	4,870	770	1,340	184	199	65	374	11	15
24	270	410	1,390	1,500	3,020	1,390	166	249	57	442	31	15
25	228	920	870	920	3,500	1,720	158	208	51	1,220	30	11
26	199	628	675	675	1,500	1,170	162	175	47	970	19	10
27	180	426	580	490	1,500	870	154	3,220	86	675	12	8
28	154	345	2,400	490	2,720	770	180	5,790	104	580	12	11
29	130	297	4,370	628	......	628	244	6,330	96	410	12	13
30	111	352	1,720	870	......	535	490	4,470	104	270	13	18
31	111	......	870	770	......	474	......	1,720	......	189	17	......

NOTE.—Daily discharge Feb. 4-15 estimated, because of ice from study of gage readings and climatic data.

Monthly discharge of Buckhannon River at Hall, W. Va., for the year ending Sept. 30, 1917.

[Drainage area, 277 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	770	88	259	0.935	1.08
November	920	63	184	.664	.74
December	4,370	166	874	3.16	3.64
January	7,540	304	1,250	4.51	5.20
February	3,500	120	852	3.08	3.21
March	8,640	474	2,470	8.92	10.28
April	2,180	154	523	1.89	2.11
May	6,330	142	918	3.31	3.82
June	1,170	47	330	1.19	1.33
July	1,220	19	248	.895	1.03
August	138	11	43.4	1.57	.18
September	338	8	57.9	.209	.23
The year	8,640	8	671	2.42	32.85

WEST FORK AT BUTCHERVILLE, W. VA.

Location.—At Weston & Clarksburg Electric Railway Co.'s trolley bridge, one-fourth mile upstream from Butcherville, Lewis County, about 3 miles north of Weston. Freemans Creek enters river on left about a mile below station.

Drainage area.—181 square miles (measured on topographic maps).

Records available.—April 8, 1915, to September 30, 1917.

Gage.—Chain gage fastened to upstream side of trolley bridge near center of span; read by Bess Ervin.

Discharge measurements.—Made from bridge or by wading.

Channel and control.—One channel except at extreme high stages, when river overflows right bank and a little water passes through two small culverts in trolley embankment; straight for 500 feet above and curved for 1,000 feet below station. Stream bed is sand and gravel, but is solid rock at riffle below gage. Control probably permanent. Growth of aquatic plants may cause backwater at gage during summer months.

Extremes of stage.—Maximum stage recorded during year, 20.01 feet at 8.30 a. m. March 12, 1917; minimum stage, 3.52 feet at 9.30 a. m. August 22, 1917.

Highest flood known is reported to have reached a stage represented by gage height of about 27 feet in 1888. Dam since washed out may have increased height of this flood.

Ice.—Stage-discharge relation affected by ice in severe winters.

Accuracy.—Stage-discharge relation probably permanent, probably affected by ice in December and February. Measurements of flow do not indicate serious backwater from growth of aquatic plants. Gage read twice daily to hundredths. Records excellent. Data inadequate for determining daily discharge.

Cooperation.—Station maintained in cooperation with United States Engineer Corps.

Discharge measurements of West Fork at Butcherville, W. Va., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Jan. 23	B. J. Peterson	7.52	706
Mar. 13	B. E. Jones	9.59	1,610
Sept. 29	Peterson and Hopkins	3.80	5.4

Daily gage height, in feet, of West Fork at Butcherville, W. Va., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	5.46	4.32	5.60	5.50	6.19	8.75	5.07	4.87	6.10	4.26	4.30	6.07
2	5.00	4.30	5.46	5.48	5.62	7.90	5.01	4.71	7.61	4.18	4.16	5.75
3	4.60	4.28	5.14	10.43	5.19	9.45	4.93	4.67	7.81	4.10	4.06	5.49
4	4.48	4.26	5.03	8.35	5.22	11.72	4.79	4.66	6.13	4.00	3.96	5.47
5	4.38	4.21	6.36	7.44	5.16	12.60	4.85	4.76	5.55	3.94	3.86	5.37
6	4.30	4.18	7.30	8.86	5.02	8.55	10.38	4.66	5.38	3.89	3.77	5.23
7	4.21	4.14	5.96	7.06	4.97	8.91	10.58	4.62	7.24	3.85	4.00	5.27
8	4.15	4.13	5.44	6.08	....	17.29	8.53	4.58	5.59	3.92	4.72	5.51
9	4.18	4.14	5.33	5.66	5.45	13.06	6.66	4.60	6.20	4.00	4.70	5.50
10	4.44	4.36	5.39	5.46	5.09	7.79	5.95	4.66	7.45	4.06	4.54	4.99
11	4.92	4.50	5.29	5.26	4.93	7.83	5.48	4.68	7.03	4.16	4.37	4.71
12	4.60	4.66	5.28	4.92	4.71	19.16	5.33	4.64	6.05	4.20	4.19	4.49
13	4.43	4.52	5.19	5.38	4.57	10.34	5.17	4.58	5.37	4.12	4.05	4.24
14	4.34	4.40	4.99	7.64	4.65	11.00	5.03	4.52	5.17	4.04	3.93	4.11
15	4.32	4.48	4.69	6.74	4.76	8.14	4.90	4.47	5.07	4.27	3.81	4.01
16	4.79	4.54	4.89	6.25	4.81	6.52	4.77	4.46	5.45	4.51	3.73	3.90
17	6.51	4.58	4.76	5.76	4.95	7.58	4.67	4.34	4.73	4.92	3.66	3.77
18	5.20	4.48	5.00	5.62	6.53	7.50	4.74	4.28	4.54	5.81	3.61	3.71
19	8.23	4.38	5.03	5.45	6.83	7.33	4.73	4.26	4.47	5.74	3.57	3.69
20	8.34	4.34	5.03	5.35	6.59	6.00	4.67	4.22	4.35	5.14	3.53	3.67
21	6.90	4.35	9.49	6.76	6.01	5.95	4.57	4.20	4.23	4.78	3.53	3.65
22	6.34	4.27	11.74	19.90	5.77	6.40	4.49	4.20	4.18	4.60	3.53	3.61
23	5.36	4.59	8.49	8.29	5.93	6.55	4.55	4.52	4.18	4.42	3.71	3.57
24	5.07	6.90	6.23	6.42	12.25	8.37	4.47	4.55	4.17	4.33	4.10	3.55
25	4.86	6.42	5.93	5.57	7.81	7.14	4.47	4.45	4.08	4.26	4.19	3.54
26	4.80	5.64	5.57	5.53	6.55	6.21	4.51	4.40	4.02	4.69	4.09	3.53
27	4.64	5.22	5.85	5.26	8.29	5.94	4.47	15.02	4.00	5.68	4.01	3.53
28	4.50	5.00	16.71	6.23	10.53	6.02	4.75	16.85	4.27	5.59	3.87	3.65
29	4.44	4.94	11.61	6.83	....	5.66	5.11	13.45	4.44	4.90	3.83	3.73
30	4.40	5.64	6.62	7.27	....	5.45	5.27	8.12	4.38	4.63	4.32	3.84
31	4.36	....	5.50	6.57	....	5.21	....	6.19	....	4.43	6.26	....

Note.—Gage heights Dec. 16, Feb. 5, 6, 7 to top of ice.

WEST FORK AT ENTERPRISE, W. VA.

Location.—At highway bridge at Enterprise, Harrison County, three-fourths mile above mouth of Bingamon Creek.

Drainage area.—750 square miles.

Records available.—June 2, 1907, to September 30, 1917.

Gage.—Chain gage attached to bridge; read by C. M. Tetrick. Sea-level elevation of zero of gage, 869.91 feet.

Discharge measurements.—Made from downstream side of bridge.

Channel and control.—Channel at measuring section broken by one pier; smooth rock bottom. Straight above and below. Control practically permanent.

Extremes of stage.—Maximum stage recorded during year, 25.35 feet at 8 a. m. January 22, 1917; minimum stage, 0.7 foot July 2, 1917.

1907–1917: Maximum stage recorded, January 22, 1917. Flood of 1888 reached stage represented by about 33 feet referred to datum of present gage.

Ice.—Stage-discharge relation may be affected by ice for short periods during December, January, and February.

Accuracy.—Stage-discharge relation practically permanent; affected by ice the first half of February and parts of December and January. A measurement made October 2, 1917, indicates a marked change in the rating curve or that the operation of the mill at the dam at Worthington about 3 miles below the gage affects the gage readings. The gates of the mill dam were open December 5–12, 1908, in order to drain the pond, but no effect was apparent on the gage readings, which may have been due to unreliable gage readings. The low-water discharge, as published in previous Water-Supply Papers, for this station may at times be in error; this condition should be observed in using the data. Gage read once daily to half-tenths. Comparison with the flow at other gaging stations in the Monongahela basin apparently indicates gage readings are unreliable at times.

The following discharge measurement was made by Peterson and Hopkins: October 2, 1917: Gage height, 1.08 feet; discharge, 10.3 second-feet.

Daily gage height, in feet, of West Fork at Enterprise, W. Va., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.90	2.45	3.45	3.70	4.70	7.20	......	2.75	4.40	......	1.75	1.85
2	2.65	1.95	3.25	3.50	4.65	6.70	2.90	2.60	4.90	0.70	1.65	......
3	2.25	1.92	2.20	4.25	4.50	5.95	2.75	2.55	......	.90	1.55	2.20
4	2.15	1.85	2.75	9.30	4.55	6.60	2.50	2.25	4.55	1.15	1.45	2.70
5	2.25	2.10	3.30	7.75	4.60	6.85	2.60	2.40	3.35	1.40	......	3.00
6	2.65	2.45	5.35	7.40	4.55	7.20	7.65	......	3.20	1.30	1.35	2.80
7	2.50	1.90	4.70	......	4.45	6.40	10.15	2.65	3.90	1.25	1.30	2.30
8	2.60	1.95	4.30	4.80	4.25	14.55	......	2.35	5.00	......	1.25	2.15
9	2.95	1.90	3.80	3.75	3.95	10.00	8.25	2.20	4.30	1.30	1.55	......
10	2.35	2.35	3.45	3.60	3.60	7.80	3.65	2.15	......	1.60	1.60	2.00
11	2.15	2.30	3.05	3.35	3.35	......	3.55	2.05	6.50	1.55	1.75	1.80
12	2.10	2.20	2.90	3.05	3.00	9.60	3.40	2.05	4.60	1.45	......	1.60
13	2.15	2.45	2.80	2.70	......	11.85	3.20	......	3.50	1.45	1.65	1.50
14	2.45	2.35	2.80	......	......	12.75	2.90	2.00	2.90	1.50	1.45	1.35
15	2.25	2.30	2.70	3.75	......	9.15	......	1.95	2.80	6.85	1.35	1.20
16	2.95	2.25	2.75	4.05	3.00	5.90	2.50	1.95	2.50	5.10	1.25	......
17	4.10	2.20	2.85	6.35	2.95	5.10	2.45	1.90	......	3.65	1.35	1.10
18	4.60	2.15	2.95	7.30	3.30	......	2.40	1.85	2.15	2.85	1.25	1.05
19	6.65	2.20	3.00	7.15	3.70	4.55	2.35	1.85	2.00	2.65	......	1.05
20	6.30	2.15	2.90	6.40	5.05	4.30	2.30	......	1.90	2.65	1.10	1.00
21	6.10	2.15	3.15	6.80	4.55	4.15	2.15	2.00	1.90	2.55	1.05	1.10
22	4.10	2.05	10.00	25.35	4.00	3.95	......	1.90	1.80	......	1.00	1.05
23	3.35	2.05	9.10	11.80	3.35	4.10	2.10	1.85	1.80	2.35	1.10	......
24	2.95	4.80	6.00	5.45	6.35	4.05	2.20	1.95	......	2.05	1.45	.95
25	2.80	5.05	4.40	5.05	7.05	......	2.05	1.90	1.70	1.85	1.30	.95
26	2.60	3.95	3.70	4.65	5.05	3.90	2.05	1.95	1.60	2.45	......	1.00
27	2.35	4.05	4.20	4.95	5.35	3.75	2.10	9.55	1.50	2.85	1.10	.95
28	2.30	4.40	10.45	4.75	5.75	3.70	2.60	14.80	1.65	2.65	1.00	1.00
29	2.20	4.85	8.05	5.40	......	3.60	......	9.50	2.65	......	.95	1.05
30	2.15	4.30	6.10	5.25	......	3.45	2.95	7.85	2.20	2.35	1.10	......
31	2.02	......	4.55	4.95	......	3.20	......	4.80	......	2.10	1.90	......

Note.—Gage readings probably affected by backwater from ice portions of December, January, and February 1-15.

ELK CREEK NEAR CLARKSBURG, W. VA.

Location.—At a footbridge near Clarksburg, Harrison County, 300 feet above Turkey Run and about 6 miles above mouth of creek.

Drainage area.—107 square miles (determined by Pittsburgh Flood Commission).

Records available.—October 11, 1910, to September 30, 1917.

Gage.—Wooden staff gage fastened to a tree near right abutment of footbridge; read by E. H. Smith. Sea-level elevation of zero of gage, 955.01 feet.

Discharge measurements.—Made from footbridge or by wading at section about 200 feet below bridge.

Channel and control.—Rocky and practically permanent; banks high and not subject to overflow. Point of zero flow, about gage height 0.9 foot.

Extremes of stage.—Maximum stage recorded during year, 11.26 feet at 10 a. m. January 22, 1917; minimum stage recorded, 1.11 feet at 10 a. m. September 24–25.

The flood of July, 1912, reached stage represented by 15 feet on the present gage.

Ice.—Stage-discharge relation may be affected by ice for short periods in December, January, and February.

Accuracy.—Stage-discharge relation practically permanent, probably affected by ice a portion of February, 1917. Gage read daily in the morning to half-tenths. Records good. Data inadequate for determination of daily discharge.

The following discharge measurements were made by B. J. Peterson and B. E. Jones, respectively:

January 23, 1917: Gage height, 3.30 feet; discharge, 500 second-feet.

March 14, 1917: Gage height, 4.21 feet; discharge, 1,010 second-feet.

Daily gage height, in feet, of Elk Creek near Clarksburg, W. Va., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.01	1.66	2.11	2.36	2.46	3.56	1.96	1.91	3.76	1.66	1.51	2.56
2	1.76	1.66	2.01	2.26	2.36	3.36	1.96	1.86	2.86	1.56	1.46	1.86
3	1.66	1.66	1.96	4.36	2.36	2.96	1.91	1.76	2.66	1.51	1.56	1.76
4	1.61	1.66	1.91	3.46	2.16	3.56	1.86	1.76	2.46	1.46	1.46	1.66
5	1.56	1.61	2.01	2.96	2.06	4.66	1.91	1.76	2.26	1.41	1.46	1.56
6	1.56	1.61	2.56	2.76	2.01	3.36	4.06	1.76	3.26	1.41	1.41	1.56
7	1.51	1.56	2.26	2.56	1.96	2.96	3.86	1.71	2.96	1.36	1.36	1.56
8	1.46	1.56	2.56	2.46	1.96	7.26	3.36	1.86	2.71	1.36	1.76	1.56
9	1.46	1.51	2.36	2.36	1.91	4.76	2.86	1.81	2.86	1.36	1.66	1.71
10	1.66	1.86	2.16	2.26	1.91	4.36	2.46	1.76	3.16	1.56	1.76	1.66
11	1.61	1.81	2.06	2.06	1.86	4.56	2.26	1.71	3.36	1.46	1.61	1.56
12	1.56	1.66	2.06	1.96	1.86	4.96	2.16	1.71	2.66	1.46	1.51	1.51
13	1.56	1.66	2.01	1.86	1.86	3.46	2.06	1.66	2.36	1.46	1.46	1.46
14	1.61	1.66	1.96	4.06	1.86	4.96	1.96	1.66	2.16	1.46	1.41	1.41
15	1.56	1.86	1.91	3.86	1.86	3.36	1.91	1.61	2.06	3.36	1.36	1.36
16	2.71	1.81	1.86	3.56	1.81	2.76	1.86	1.61	2.06	2.96	1.36	1.36
17	3.76	1.76	1.86	3.36	1.81	3.06	1.81	1.56	1.86	2.06	1.31	1.31
18	2.66	1.71	1.81	2.86	1.86	2.86	1.86	1.56	1.81	1.86	1.26	1.26
19	4.56	1.66	1.81	2.36	2.36	2.66	1.86	1.51	1.76	1.96	1.26	1.26
20	3.76	1.66	1.76	1.86	2.56	2.46	1.81	1.51	1.71	1.76	1.26	1.26
21	2.91	1.61	3.86	1.86	2.46	2.36	1.81	1.46	1.66	1.91	1.26	1.26
22	2.46	1.61	6.26	11.26	2.26	2.26	1.76	1.46	1.61	1.86	1.26	1.21
23	2.16	1.56	3.36	3.26	2.26	2.26	1.71	1.66	1.56	1.66	1.36	1.16
24	1.96	2.96	2.56	2.76	3.76	3.56	1.66	1.71	1.56	1.61	1.31	1.11
25	1.86	2.76	2.36	2.56	2.96	2.96	1.66	1.66	1.56	2.66	1.26	1.11
26	1.81	2.36	2.26	2.36	2.56	2.56	1.61	1.61	1.56	1.86	1.26	1.16
27	1.76	2.06	2.71	2.16	2.96	2.36	1.61	5.56	1.56	2.16	1.21	1.16
28	1.76	1.86	5.96	2.06	4.46	2.36	1.76	7.46	1.51	2.11	1.16	1.26
29	1.71	1.96	3.36	2.56	......	2.26	2.06	5.06	1.96	1.81	1.16	1.26
30	1.66	2.16	2.86	2.96	......	2.06	1.96	3.16	1.76	1.66	1.31	1.21
31	1.66	......	2.56	2.66	......	2.01	......	3.56	......	1.61	1.36	......

BUFFALO CREEK AT BARRACKVILLE, W. VA.

Location.—At steel highway bridge about 1,000 feet above covered highway bridge at Barrackville, Marion County, 2¾ miles northwest of Fairmont. Finch's Run enters on left about 1,600 feet below station.

Drainage area.—115 square miles (measured on topographic maps).

Records available.—May 8, 1915, to September 30, 1917; June 3, 1907, to December 31, 1908.

Gage.—Chain gage fastened to downstream hand rail of bridge; read by E. M. Beall.

Discharge measurements.—Made from highway bridge or by wading. Stay wire is used for measurements at high stages.

Channel and control.—One channel at all stages; straight about 100 feet above and below station. Both banks high. Stream bed rocky, some gravel. Control changes during severe floods.

Extremes of discharge.—Maximum stage recorded during year, 14.22 feet at 7.45 a. m. January 22, 1917 (discharge about 6,800 second-feet); minimum discharge, 0.4 second-foot Sept. 22–30.

Flood of July, 1912, reached a stage represented by about 16 feet on present gage.

Ice.—Stage-discharge relation affected by ice during severe winters.

Accuracy.—Stage-discharge relation not permanent, changed during the flood of January 22, 1917. Rating curve used October 1, 1916, to January 21, 1917, and curve used January 22 to September 30, 1917, well defined below 1,600 second-feet; above 1,600 second-feet, the curve is an extension. Gage read twice daily to hundredths except Sunday, when gage is read once. Daily discharge ascertained by applying mean daily gage heights to rating table except as follows: October 27, December 3, 4, 5, July 16, discharge interpolated because of missing gage readings. December 15–20, and February 4–19, estimated because of ice. Records good except those interpolated or estimated, which are poor.

Cooperation.—Station maintained in cooperation with United States Engineer Corps.

The following discharge measurement was made by B. J. Peterson and B. L. Hopkins: October 3, 1917: Gage height, 0.67 foot; discharge, 0.55 second-foot.

Daily discharge, in second-feet, of Buffalo Creek at Barrackville, W. Va., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	5.9	4.1	47	58	222	176	48	87	1,420	8.0	7.2	330
2	4.6	3.8	42	47	132	184	48	73	1,260	4.5	4.6	49
3	3.8	3.8	40	720	76	167	47	59	258	3.8	4.0	40
4	3.5	5.4	38	672		184	37	54	159	3.1	3.4	22
5	3.0	4.3	36	873		271	108	61	98	2.8	3.1	16
6	2.5	3.8	34	821		193	1,260	49	1,530	2.1	2.9	5.4
7	2.0	3.8	27	409		271	873	42	1,090	2.1	2.6	6.5
8	1.5	3.4	23	143		2,370	426	49	345	2.2	2.1	5.4
9	1.1	3.3	21	108		821	212	48	330	2.8	2.1	23
10	1.6	4.6	26	79		582	143	43	720	4.1	1.7	15
11	1.4	34	21	35	30	1,360	102	37	315	12.0	1.6	7.2
12	1.1	26	28	31		873	88	36	151	6.5	1.6	4.6
13	1.0	14	34	31		1,750	76	32	95	4.5	2.1	4.0
14	.9	17	30	30		1,310	64	31	44	8.0	1.7	3.1
15	1.0	26		114		481	59	28	50	28	1.6	2.6
16	2.2	34		159		234	47	24	42	75	2.2	2.1
17	8.0	30	20	102		672	40	22	30	130	1.7	1.7
18	76	23		79		360	37	20	26	111	1.1	1.1
19	167	19		64		176	42	18	20	81	1.4	1.1
20	212	16		53	95	143	43	15	17	40	1.7	1.1
21	184	12	58	77	84	132	37	12	14	24	1.4	.6
22	132	8.0	770	3,750	72	167	34	9.8	11	74	1.1	.4
23	42	20	212	409	90	184	30	36	8.9	99	3.8	.4
24	28	330	159	184	1,260	770	28	40	5.9	43	60	.4
25	23	392	123	135	481	540	35	24	4.8	23	28	.4
26	19	481	81	84	167	167	47	19	4.5	18	18	.4
27	15	167	2,250	52	176	123	64	286	4.1	47	5.0	.4
28	9.8	42	1,750	54	222	105	79	2,060	4.0	37	4.0	.4
29	7.2	40	444	345	....	87	108	1,200	4.6	27	2.9	.4
30	4.3	47	167	582	....	64	120	300	14.0	18	2.1	.4
31	3.1	....	105	271	....	52	....	143	....	12	2.6	....

Monthly discharge of Buffalo Creek at Barrackville, W. Va., for the year ending Sept. 30, 1917.

[Drainage area, 115 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	212	0.9	31.2	0.271	0.31
November	481	3.3	60.6	.527	.59
December	2,250	....	216	1.88	2.17
January	3,750	30	341	2.97	3.42
February	1,260	....	127	1.10	1.14
March	2,370	52	483	4.20	4.84
April	1,260	28	146	1.27	1.42
May	2,080	9.8	161	1.40	1.61
June	1,530	4.0	269	2.34	2.61
July	130	2.1	30.8	.268	.31
August	60	1.1	5.61	.049	.06
September	330	.4	18.2	.158	.18
The year	3,750	.4	158	1.37	18.66

CHEAT RIVER NEAR PARSONS, W. VA.

Location.—At Moss highway bridge, 2 miles north of Parsons, Tucker County, 2 miles below junction of Shavers Fork, and 5 miles below junction of Dry Fork and Blackwater River.

Drainage area.—716 square miles (determined by Hydroelectric Co. of West Virginia).

Records available.—January 1, 1913, to September 30, 1917.

Gage.—Chain gage near center of bridge on downstream guard rail; read by Mrs. E. C. Linger.

Discharge measurements.—Made from downstream side of highway bridge.

Channel and control.—Rocky and probably permanent. Water is swift and turbulent.

Extremes of discharge.—Maximum stage recorded during year, 17.98 feet at 7 a. m. March 12 (discharge about 40,000 second-feet); minimum stage, 1.52 feet at 7 a. m. November 1 (discharge, 29 second-feet).

Ice.—Stage-discharge relation affected by ice during severe winters.

Regulation.—Some regulation above at various pulp mills and sawmills. Effect probably compensating, so that two gage readings per day give correct basis for determining discharge.

Accuracy.—Stage-discharge relation practically permanent; probably affected by ice for short periods in December, January and February. Rating curve fairly well defined between 65 and 5,500 second-feet. Beyond these limits the curve is an extension and may be in considerable error. Gage read twice daily to quarter tenths. Daily discharge ascertained by applying mean daily gage heights to rating table. Discharge December 10–22, 29–31, January 12–20, and February 2–17, may be somewhat large due to not correcting discharge for effect of ice on gage readings. Records fair except for those periods effected by ice, which are poor.

Cooperation.—Station maintained in cooperation with the Hydroelectric Co. of West Virginia.

The following discharge measurement was made by B. J. Peterson and B. L. Hopkins:

September 25: Gage height, 1.88 feet, discharge, 74 second-feet.

Daily discharge, in second-feet, of Cheat River near Parsons, W. Va., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	5,480	865	310	2,670	1,600	4,550	820	1,290	3,000	290	207	262
2	4,020	552	240	4,370	1,180	4,190	865	960	2,590	300	207	231
3	2,830	452	163	5,880	960	3,680	820	865	1,890	253	207	120
4	1,060	363	127	7,660	960	3,340	517	1,060	1,350	215	155	43
5	433	262	93	13,200	865	2,830	1,010	1,120	1,120	187	191	32
6	363	203	117	10,400	778	2,350	1,960	865	865	187	248	35
7	310	175	85	6,090	865	2,430	2,350	695	910	240	207	695
8	325	330	152	5,100	695	6,520	2,040	1,010	865	235	330	3,680
9	320	258	191	4,190	820	7,200	1,540	865	778	253	559	910
10	300	385	148	3,340	655	5,680	1,670	778	2,040	187	510	865
11	271	305	102	2,510	566	11,200	2,670	695	2,120	187	330	439
12	227	310	70	1,670	552	35,900	2,430	618	1,960	187	248	315
13	195	320	65	1,120	484	15,900	2,120	820	1,600	171	207	266
14	159	276	58	1,060	421	10,900	1,740	820	1,180	300	191	235
15	271	253	330	910	421	10,600	1,540	735	910	203	183	199
16	2,040	227	330	1,060	484	8,860	1,350	640	778	409	144	171
17	3,850	244	231	865	497	7,200	1,230	588	595	458	105	215
18	3,340	203	820	1,120	655	6,300	1,350	545	380	910	90	144
19	3,000	163	2,270	1,120	1,010	5,680	1,290	478	290	820	82	90
20	4,190	141	2,270	960	3,850	5,100	1,180	427	203	510	63	80
21	6,300	148	1,890	1,540	4,020	6,740	960	421	148	865	54	65
22	5,290	195	1,890	32,700	2,590	6,090	778	433	124	478	47	248
23	4,370	421	2,190	9,600	2,190	5,100	573	439	93	695	42	102
24	3,850	1,120	1,670	1,670	3,000	3,850	497	820	510	458	99	88
25	3,340	910	1,180	1,410	2,590	3,340	415	655	341	655	72	78
26	2,830	778	865	1,180	3,000	3,170	397	566	244	1,290	49	68
27	2,510	573	2,830	960	4,730	3,680	439	8,380	735	1,060	35	56
28	2,190	545	4,020	820	5,480	2,830	865	8,860	497	625	54	271
29	1,820	504	3,680	1,010	....	2,190	1,540	15,300	695	510	102	735
30	1,470	391	2,670	960	....	1,600	1,230	5,880	655	403	258	1,120
31	1,120	....	1,010	1,740	....	1,230	....	4,370	....	248	305	....

Monthly discharge of Cheat River near Parsons, W. Va., for the year ending Sept. 30, 1917.

[Drainage area, 716 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	6,300	159	2,200	3.07	3.54
November	1,120	141	396	.553	.62
December	4,020	58	1,030	1.44	1.66
January	32,700	820	4,160	5.81	6.70
February	5,480	421	1,640	2.29	2.38
March	35,900	1,230	6,460	9.02	10.40
April	2,670	397	1,270	1.77	1.98
May	15,300	421	2,000	2.79	3.22
June	3,000	93	982	1.37	1.53
July	1,290	171	445	.622	.72
August	559	35	180	.251	.29
September	3,680	32	395	.552	.62
The year	35,900	32	1,780	2.49	33.66

CHEAT RIVER AT ROWLESBURG, W. VA.

Location.—At Baltimore & Ohio Railroad bridge at Rowlesburg, Preston County, about 300 feet above mouth of Salt Lick Creek.

Drainage area.—960 square miles (includes drainage area of Salt Lick Creek).

Records available.—July 19, 1912, to September 30, 1917. The United States Weather Bureau has collected gage-height records since 1884.

Gage.—Mott tape gage attached to upstream side of bridge; read by J. F. Pierce.

Discharge measurements.—Made from upstream side of bridge. Salt Lick Creek is measured separately and the discharge added to that measured at the bridge.

Channel and control.—Stream is curved above and below bridge; control consists of small boulders; probably permanent. Salt Lick Creek enters between the control and the gage. Stage at which flow would be zero was about 0.45 foot in September, 1917.

Extremes of stage.—Maximum stage recorded during year, 12.8 feet March 12; minimum stage, 2.0 feet August 20, 22, 23, 29, and September 23.

The highest stage of which there is any record occurred, according to the United States Weather Bureau, July 10, 1888, when the water reached a stage of 22 feet.

Ice.—Stage-discharge relation affected by ice during severe winters.

Accuracy.—Stage-discharge relation probably permanent; affected by ice December 16-21, January 15-21, and February 4-18. Data inadequate for determining daily discharge. Gage read daily in the morning to tenths.

Cooperation.—Gage-height record furnished by the United States Weather Bureau.

The following measurements were made by B. J. Peterson and B. L. Hopkins September 20, 1917: Gage height, 2.23 feet; discharge, 161 second-feet. Gage height, 2.22 feet; discharge, 155 second-feet.

Daily gage height, in feet, of Cheat River at Rowlesburg, W. Va., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	4.1	2.3	3.0	3.8	4.2	5.2	3.6	4.0	4.6	3.1	2.6	2.6
2	3.4	2.5	3.0	3.6	4.5	4.5	3.5	3.8	4.3	2.8	2.5	2.7
3	3.0	2.4	2.9	3.4	4.3	4.3	3.5	3.5	4.2	2.6	2.4	2.4
4	2.8	2.4	2.8	5.8	3.4	4.9	3.5	3.3	3.9	2.9	2.9	2.3
5	2.5	2.4	2.8	4.9	3.4	4.8	3.4	3.3	3.6	2.6	2.7	2.2
6	2.5	2.3	3.5	6.1	3.2	4.3	3.9	3.3	3.4	2.5	2.5	2.2
7	2.4	2.3	3.3	5.6	3.4	4.0	4.6	3.3	3.8	2.5	2.7	2.3
8	2.3	2.2	3.1	4.6	3.4	6.0	4.9	3.2	3.7	2.9	2.4	3.5
9	2.3	2.3	3.0	4.0	3.4	6.9	4.6	3.2	3.4	2.6	3.2	4.8
10	2.5	2.6	2.9	3.8	3.4	5.2	4.2	3.9	3.3	2.5	3.0	3.5
11	2.7	2.5	2.8	3.6	3.4	5.5	4.3	3.8	3.7	2.5	2.9	3.1
12	2.6	2.4	2.8	3.2	3.4	12.8	5.2	3.6	3.6	2.4	2.7	2.8
13	2.4	2.3	2.9	2.9	3.4	9.6	5.2	3.5	3.4	2.3	3.5	2.6
14	2.2	2.6	2.7	3.2	3.4	8.7	4.7	3.4	3.1	2.3	2.4	2.5
15	2.4	2.5	2.5	3.8	3.4	8.5	4.2	3.3	2.9	2.2	2.4	2.4
16	2.9	2.4	2.5	3.8	3.4	6.2	3.9	3.2	2.9	3.0	2.3	2.4
17	4.8	2.4	2.5	3.8	3.4	5.3	3.6	3.1	2.9	2.9	2.3	2.3
18	4.0	2.3	2.5	3.8	3.4	6.3	3.4	3.0	2.8	2.7	2.3	2.2
19	4.1	2.3	2.5	3.8	3.5	5.3	3.5	2.9	2.7	3.0	2.1	2.2
20	4.6	2.2	2.5	3.8	3.9	4.7	3.4	2.8	2.6	3.1	2.0	2.2
21	4.0	2.3	2.5	3.8	4.9	4.6	3.3	2.8	2.6	2.8	2.1	2.2
22	3.9	2.2	5.4	12.0	4.4	5.4	3.3	2.8	2.6	3.0	2.0	2.1
23	3.5	2.2	4.9	7.2	3.9	5.3	3.1	2.8	2.5	2.9	2.0	2.0
24	3.2	2.6	4.4	5.2	4.6	5.1	3.0	2.9	2.5	2.8	2.2	2.1
25	3.0	4.0	3.7	4.3	6.2	6.2	2.9	2.8	2.5	2.7	2.3	2.1
26	2.9	3.4	3.4	3.8	4.8	5.0	2.9	2.7	2.6	2.9	2.2	2.1
27	2.7	3.0	3.4	3.5	4.4	4.5	3.0	4.2	2.4	3.7	2.1	2.1
28	2.7	2.9	6.5	3.4	6.3	4.3	3.0	8.0	2.4	3.6	2.1	2.1
29	2.6	2.8	7.0	3.4	......	4.0	3.5	7.9	2.8	3.1	2.0	2.1
30	2.5	2.9	5.5	4.5	......	3.9	4.4	7.4	3.3	2.9	2.1	2.2
31	2.4	......	4.2	4.7	......	3.7	......	5.5	......	2.7	2.2	......

CHEAT RIVER NEAR MORGANTOWN, W. VA.

Location.—At highway bridge at Uneva, Monongalia County, 10 miles above mouth of river. Parallel of 39° 40′ crosses the river at this bridge.

Drainage area.—1,380 square miles.

Records available.—July 8 to December 30, 1899; July 1 to December 29, 1900; August 21, 1902, to December 31, 1905; November 18, 1908, to September 30, 1917.

Gage.—Chain gage attached to bridge; read by C. F. Baker.

Discharge measurements.—Made from upstream side of bridge or by wading.

Channel and control.—Probably permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.67 feet at 5 p. m. March 12 (discharge about 51,000 second-feet); minimum stage, 1.97 feet August 30 and several days the latter part of September (discharge, 162 second-feet).

ICE.—Ice forms sometimes to a thickness of several inches, and large ice jams may affect the stage-discharge relation during short periods in December, January, and February.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice portions of December, January, and February. Rating curve used for 1917 fairly well defined above 175 second-feet. Discharge measurements made November 30, 1914, October 4 and 5, 1917, indicate a marked change in the stage-discharge relation below gage height 2.4 feet (discharge, 410 second-feet) and a new rating curve was drawn for 1917. Change from the former rating curve ranges from 0 at discharge 445 second-feet to 30 per cent at discharge 163 second-feet, the rating curve for 1917 giving smaller results. Date of change not known, but may have been some time during 1914. In view of the uncertainty in the date of this change in stage-discharge relation, estimates of daily discharge for the years 1914 to 1916 may be subject to considerable error below 410 second-feet. Gage read twice daily to hundredths. Daily discharge ascertained by applying mean daily gage heights to the rating table. Discharge interpolated because of missing gage readings, October 28, November 4, 6, 12, 23, December 12, 25, January 13, February 28, April 5, May 10, 26, July 29, September 9, 16; estimated because of ice from climatic data and observer's notes, December 15–21, January 15, 16, 19, 20, February 11, 18. Results good except for periods probably affected by ice, December 10–22, January 15, 16, and February 6–20, for which they are probably poor.

The following discharge measurements were made by Peterson and Hopkins:

October 4, 1917: Gage height, 2.06 feet; discharge, 192 second-feet.

October 5, 1917: Gage height, 2.06 feet; discharge, 196 second-feet.

Daily discharge, in second-feet, of Cheat River near Morgantown, W. Va., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,860	600	1,530	3,150	4,900	8,530	1,960	3,150	8,020	1,010	520	600
2	1,530	560	1,360	2,580	5,110	5,550	1,840	2,580	7,510	782	480	685
3	950	560	1,220	3,620	2,200	4,510	1,840	1,960	5,110	600	892	480
4	730	925	1,080	11,600	2,080	6,500	1,840	1,530	3,460	480	685	345
5	560	1,290	1,080	9,040	1,630	6,500	2,650	1,630	2,450	410	685	303
6	480	965	1,530	13,600	1,360	3,790	3,460	1,840	2,450	345	560	560
7	520	640	1,730	10,100	1,840	3,460	5,330	1,630	14,100	315	431	640
8	473	560	1,290	6,020	1,530	14,100	8,020	1,630	6,020	321	520	1,730
9	424	520	1,140	3,960	1,220	16,700	6,020	1,630	3,620	466	730	2,020
10	520	892	1,140	3,300	950	9,550	4,140	2,170	3,300	452	1,010	2,320
11	560	950	1,010	2,450	743	14,100	4,140	2,710	3,150	445	730	1,220
12	640	840	922	1,730	520	45,800	7,510	2,450	2,710	384	600	782
13	600	730	835	2,290	480	28,400	7,000	2,080	1,960	384	466	640
14	452	950	782	2,860	520	26,900	5,110	1,730	1,530	358	404	520
15	431	835	651	2,640	520	24,300	3,460	1,630	1,290	2,080	410	452
16	685	835	520	2,420	520	13,600	2,450	1,450	1,140	2,710	520	396
17	4,900	835	520	2,200	560	10,600	2,080	1,290	1,010	1,840	397	339
18	3,790	730	520	1,360	726	13,600	1,730	1,080	835	1,080	384	309
19	4,700	560	520	1,310	892	8,020	1,630	1,010	782	950	279	279
20	6,020	600	520	1,270	1,840	6,020	1,630	1,220	835	1,140	243	255
21	4,140	560	520	1,220	7,510	5,330	1,450	892	560	892	220	255
22	3,150	520	8,020	42,700	5,110	10,100	1,360	782	600	892	200	231
23	1,960	1,240	9,040	18,200	3,150	8,020	1,220	730	560	950	200	185
24	1,630	1,960	4,140	9,550	10,100	8,020	1,220	892	480	892	782	171
25	1,220	3,620	3,230	5,110	11,600	12,100	1,220	782	459	640	438	180
26	1,080	2,710	2,320	3,620	7,000	7,000	1,220	4,660	600	892	327	167
27	782	1,530	12,600	3,000	6,500	4,700	1,220	8,530	473	2,450	291	167
28	498	1,220	21,800	2,200	7,520	3,790	1,290	22,800	431	1,630	225	157
29	215	1,080	17,200	2,320	....	3,150	2,080	23,300	600	1,290	195	200
30	640	1,290	8,530	3,790	....	2,710	3,790	18,700	892	950	163	195
31	640	....	4,700	6,500	....	2,320	....	10,100	....	640	200	....

Monthly discharge of Cheat River near Morgantown, W. Va., for the year ending Sept. 30, 1917.

[Drainage area, 1,380 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	6,020	215	1,540	1.12	1.29
November	3,620	520	1,040	.754	.84
December	21,800	520	3,610	2.62	3.02
January	42,700	1,220	5,990	4.34	5.00
February	11,600	480	3,170	2.30	2.40
March	45,800	2,320	10,900	7.90	9.11
April	8,020	1,220	3,000	2.17	2.42
May	23,300	730	4,150	3.01	3.47
June	14,100	431	2,560	1.86	2.08
July	2,710	315	925	.670	.77
August	1,010	163	458	.332	.38
September	2,320	167	560	.406	.45
The year	45,800	163	3,180	2.30	31.23

BLACKWATER RIVER AT HENDRICKS, W. VA.

LOCATION.—At highway bridge at Hendricks, Tucker County, about one-eighth mile above mouth of river.

DRAINAGE AREA.—148 square miles (deterimined by West Virginia Development Co.).

RECORDS AVAILABLE.—October 13, 1911, to September 30, 1917.

GAGE.—Chain gage attached to upstream side of bridge; read by French Shaffer.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Coarse gravel and stones.

EXTREMES OF STAGE.—Maximum stage recorded during year, 8.37 feet at 7 a. m. March 12; minimum stage, 1.49 feet at 5 p. m. October 15.

1911–1917: Extremes of stage are those recorded above.

Maximum flood occurred July 10, 1888, stage unknown.

ICE.—Stage-discharge relation probably affected by ice during extremely cold weather.

ACCURACY.—Station was first visited by engineers of the Survey in March, 1916. Discharge measurements made at gage heights 3.42 and 4.27 during these visits plot respectively 17 and 30 per cent below rating curve used from 1911 to 1914. Monthly discharge for 1914 as published in Water-Supply Paper 383 probably as accurate as indicated. Discharge data subsequent to 1914 withheld for additonal information. Gage read twice daily to tenths to April 1, then to hundredths. Gage readings probably affected by ice January 17 to February 20. Records good.

COOPERATION.—Station maintained and records furnished by the Hydro-Electric Co. of West Virginia.

The following discharge measurement was made by Peterson and Hopkins: September 24: Gage height, 1.64 feet, discharge, 9.1 second-feet.

Daily gage height, in feet, of Blackwater River at Hendricks, W. Va., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.75	1.86	2.37	3.10	3.04	3.08	2.40	2.52	3.48	2.14	1.94	2.12
2	2.54	1.82	2.33	3.37	2.54	2.90	2.56	2.48	2.74	2.07	1.90	2.06
3	2.21	1.88	2.20	3.64	3.52	2.72	2.49	2.46	2.44	1.98	1.89	2.10
4	2.09	1.92	2.15	3.57	5.85	3.25	2.48	2.46	2.36	1.93	1.88	2.14
5	1.97	1.87	2.56	3.80	6.43	3.26	2.88	2.46	2.32	1.90	1.86	2.10
6	1.92	1.84	2.78	3.32	6.43	2.88	2.88	2.42	2.68	1.90	1.86	2.06
7	1.60	1.82	2.50	3.04	6.43	2.71	2.74	2.40	2.58	2.16	1.85	2.22
8	1.57	1.86	2.46	2.95	6.43	5.08	2.72	2.43	2.44	2.24	1.86	2.50
9	1.66	1.92	2.44	2.84	6.43	4.77	2.62	2.44	2.46	2.06	2.42	2.38
10	2.20	1.94	2.40	2.74	6.43	3.00	2.52	2.42	2.50	2.00	2.18	2.13
11	1.66	1.92	2.38	2.49	6.43	4.80	3.00	2.40	2.54	1.97	1.97	2.00
12	1.84	1.95	2.36	2.46	6.12	7.69	3.49	2.36	2.48	1.96	1.90	1.87
13	1.66	2.27	2.34	3.04	6.12	5.61	3.06	2.34	2.46	1.97	1.84	1.82
14	1.58	2.10	2.38	2.90	6.11	4.88	2.80	2.32	2.42	2.01	1.86	1.82
15	1.52	2.00	2.41	2.76	5.94	4.32	2.70	2.29	2.30	2.08	1.92	1.79
16	3.46	1.96	2.42	2.56	5.80	3.72	2.69	2.26	2.26	2.17	1.88	1.92
17	4.34	2.00	2.44	2.46	5.73	3.70	2.65	2.24	2.24	2.26	1.82	1.90
18	3.14	1.90	2.40	2.39	5.72	3.58	2.65	2.23	2.12	2.24	1.79	1.90
19	3.84	1.88	2.58	2.29	5.39	3.36	2.60	2.22	2.09	2.20	1.78	1.86
20	3.60	1.74	2.46	2.26	3.38	3.23	2.59	2.22	2.06	2.15	1.76	1.82
21	3.27	1.72	2.86	4.20	3.05	3.62	2.54	2.22	2.04	2.12	1.74	1.80
22	2.80	1.70	2.55	6.74	2.70	3.60	2.52	2.20	2.02	2.16	1.74	1.78
23	2.60	1.88	2.42	4.23	3.01	3.60	2.46	2.34	2.02	2.18	1.76	1.78
24	2.52	2.26	2.38	3.48	4.92	3.76	2.39	2.26	1.99	2.16	1.76	1.63
25	2.42	2.42	2.36	2.88	3.38	3.36	2.54	2.16	1.98	2.18	1.74	1.68
26	2.31	2.37	2.39	2.66	2.84	2.95	2.60	2.08	1.96	2.22	1.76	1.68
27	2.29	2.58	3.39	2.48	3.76	2.86	2.37	3.36	1.96	2.18	1.79	1.68
28	2.16	2.78	4.12	2.60	3.66	2.78	2.78	4.38	2.16	2.16	1.78	1.77
29	2.11	2.69	3.68	3.57	....	2.67	2.85	4.67	2.30	2.15	1.74	1.78
30	2.06	2.46	3.47	3.38	....	2.54	2.62	3.66	2.22	2.11	1.84	1.75
31	1.97	....	3.29	3.00	....	2.50	....	3.38	....	2.02	2.20	....

SHAVERS FORK AT PARSONS, W. VA.

Location.—At steel highway bridge 600 feet northwest of railroad station at Parsons, Tucker County, and half a mile above confluence with Dry Fork.

Drainage area.—210 square miles (determined by Pittsburgh Flood Commission).

Records available.—October 14, 1910, to September 30, 1917.

Gage.—Standard chain gage attached to bridge, read by R. W. Evans. Sea-level elevation of zero of gage, 1,631.70 feet.

Discharge measurements.—Made from downstream side of bridge or by wading.

Channel and control.—Channel rocky. Control, coarse gravel and rocks; probably permanent.

Extremes of discharge.—Maximum stage recorded during year, 9.90 feet at 8 a. m. March 12 (discharge, 12,300 second-feet); minimum stage, 2.15 feet September 8 (discharge, 3 second-feet).

High waters of 1868 and 1907 reached a stage represented by approximately 12.5 feet, referred to present gage datum.

Ice.—Stage-discharge relation affected by ice during severe winters.

Regulation.—The flow at low stages may be affected by the storage of water at a pulp mill dam about three-fourths mile above the station.

ACCURACY.—Stage-discharge relation practically permanent, affected by ice December 13–20, and February 6–16. A discharge measurement made in September, 1917, indicated a change in the stage-discharge relation below 300 second-feet. It was assumed that the change in relation occurred during the high water of March. Rating curve used to March 11, and curve used March 12 to September 30, well defined between 40 and 10,000 second-feet; beyond these limits curve is an extension. Gage read twice daily to tenths. Daily discharge ascertained by applying mean daily gage heights to rating table. Results good except for periods affected by ice, for which they are poor.

The following discharge measurement was made by Peterson and Hopkins: September 24: Gage height 2.82 feet, discharge, 48 second-feet.

Daily discharge, in second-feet, of Shavers Fork at Parsons, W. Va., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	520	78	183	402	960	1,320	260	562	1,020	30	61	30
2	440	88	183	295	1,140	1,200	440	520	960	104	54	22
3	183	52	183	1,020	1,260	1,200	402	365	750	54	46	22
4	183	88	128	1,260	1,140	2,510	365	260	480	54	50	15
5	144	52	183	1,080	905	2,000	562	199	480	54	54	15
6	113	52	144	3,350		750	800	199	365	46	40	54
7	88	52	144	1,020		750	700	199	260	199	25	480
8	88	60	144	800		2,510	852	750	199	330	154	1,460
9	88	39	164	520		1,720	800	852	199	54	199	652
10	113	52	144	365		960	605	750	260	54	199	652
11	144	52	128	295	60	2,510	652	480	480	225	260	120
12	100	46	128	144		12,300	905	480	295	54	154	120
13	88	52		138		3,900	852	480	260	54	46	120
14	78	78		113		4,090	700	365	225	54	61	120
15	88	68		295		3,530	562	365	154	70	40	154
16	144	60	100	520		1,590	562	330	154	104	40	154
17	233	60		330	100	1,590	440	260	135	104	46	22
18	295	68		295	144	2,220	402	199	80	562	40	3
19	440	52		264	144	1,020	402	199	75	154	30	30
20	520	52		295	537	852	330	199	70	154	25	23
21	605	52	183	520	1,520	852	330	120	70	330	22	25
22	605	52	1,260	6,330	1,260	2,670	330	120	61	199	30	15
23	365	88	1,790	1,660	562	1,390	225	154	61	199	18	22
24	605	144	1,930	800	1,930	3,000	199	154	54	199	15	22
25	520	144	365	605	2,000	2,000	199	135	40	440	15	40
26	520	113	295	365	1,020	1,790	199	154	30	1,590	22	38
27	440	113	233	264	1,260	800	173	3,350	40	1,520	15	41
28	183	113	3,900	233	1,720	750	173	3,170	54	1,390	15	40
29	183	113	2,510	309	....	605	800	4,670	520	1,320	15	36
30	88	100	905	652	....	480	800	3,170	480	1,080	22	36
31	88	....	520	905	....	225	....	1,260	....	135	40	....

NOTE.—Daily discharge estimated because of ice from climatic data and observer's notes Dec. 13–20, Feb. 6–16, braced figures show the mean discharge for the period. Discharge interpolated June 19, Aug. 4.

Monthly discharge of Shavers Fork at Parsons, W. Va., for the year ending Sept. 30, 1917.

[Drainage area, 210 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	605	78	267	1.27	1.46
November	144	39	74.4	.354	.40
December	3,900	....	534	2.54	2.93
January	6,330	113	821	3.91	4.51
February	2,000	....	652	3.11	3.24
March	12,300	225	2,030	9.67	11.15
April	905	173	501	2.39	2.67
May	4,670	120	789	3.76	4.34
June	1,020	30	277	1.32	1.47
July	1,590	30	352	1.68	1.94
August	260	15	59.8	.285	.33
September	1,460	3	153	.729	.81
The year	12,300	3	545	2.60	35.25

BIG SANDY CREEK AT ROCKVILLE, W. VA.

Location.—At the highway bridge at Rockville, in Preston County, about 5 miles above mouth of creek and 6 miles below Bruceton Mills.

Drainage area.—202 square miles (determined by West Virginia Development Co.).

Records available.—May 7, 1909, to September 30, 1917.

Gage.—Chain gage attached to downstream side of bridge; read by A. A. Christopher and Levi Zweyer.

Discharge measurements.—Made from bridge or by wading.

Channel and control.—Channel bed consists of boulders and bed rock. Control practically permanent.

Extremes of discharge.—Maximum stage recorded during year, 14.98 feet at 6 a. m. January 22 (discharge about 17,500 second-feet); minimum stage, 3.10 feet October 9 (discharge, 8.1 second-feet).

Ice.—Stage-discharge relation affected by ice during periods of extremely cold weather.

Regulation.—Gristmills at Rockville, Clifton Mills, and Bruceton Mills operated by water power, may produce fluctuations in stage during low water.

Accuracy.—Stage-discharge relation practically permanent. Affected by ice December 13–20 and probably to some extent during parts of January and February. Rating curve well defined between 10 and 8,000 second-feet; beyond these limits curve is an extension. Gage read twice daily to tenths. Daily discharge ascertained by applying mean daily gage heights to rating table. Results good except for periods affected by ice for which they are poor.

Daily discharge, in second-feet, of Big Sandy Creek at Rockville, W. Va., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	31	68	299	739	1,310	684	299	330	1,430	48	23	45
2	27	52	269	465	633	633	284	269	1,690	24	35	65
3	18	47	215	429	330	523	203	241	1,310	31	203	33
4	12	299	203	1,010	447	465	169	215	633	18	142	46
5	12	931	255	1,310	346	412	447	299	447	17	81	30
6	12	395	180	1,690	299	412	684	362	484	16	61	87
7	12	228	160	1,010	269	330	931	314	6,920	22	50	77
8	11	180	142	739	299	1,950	1,430	299	1,430	16	50	395
9	8.1	191	150	543	255	1,560	739	465	1,200	33	96	412
10	16	465	133	447	180	931	523	633	1,010	70	78	228
11	13	586	133	346	150	4,230	586	465	862	61	50	150
12	28	284	150	203	150	7,340	543	412	633	41	31	133
13	22	255		269	150	2,080	447	330	378	32	29	96
14	16	299		684	150	3,720	395	284	314	60	27	80
15	17	395		503	142	3,550	330	228	241	484	314	54
16	50	330	100	586	133	1,820	255	215	215	633	126	49
17	314	241		412	133	2,080	284	191	160	314	88	43
18	215	215		465	215	1,560	203	169	142	203	77	45
19	586	169		378	299	1,200	215	150	126	142	42	27
20	633	169		314	543	1,200	203	142	118	110	41	41
21	523	150	412	330	447	739	180	126	103	110	30	22
22	330	118	1,950	13,400	264	684	169	133	88	103	22	30
23	215	133	1,200	2,930	255	931	142	150	68	96	314	16
24	169	1,200	633	1,310	4,060	798	160	126	65	84	447	24
25	133	633	543	798	1,200	739	299	110	50	88	169	26
26	126	447	378	523	798	684	362	103	42	160	49	13
27	103	362	6,920	330	1,200	484	314	255	32	126	60	10
28	88	269	6,710	378	1,010	465	330	3,390	40	81	33	19
29	88	269	2,220	412	......	378	412	3,080	56	50	47	24
30	71	395	1,100	1,690	......	314	346	1,430	56	68	87	27
31	71	......	920	798	......	284	....	931	......	25	215	......

Note.—Daily discharge estimated because of ice from climatic data December 13–20, interpolated December 31 on account of missing gage reading

Monthly discharge of Big Sandy Creek at Rockville, W. Va., for the year ending Sept. 30, 1917.

[Drainage area, 202 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	633	8.1	128	0.634	0.73
November	1,200	47	326	1.61	1.80
December	6,920		841	4.16	4.80
January	13,400	203	1,140	5.64	6.50
February	4,060	133	560	2.77	2.88
March	7,340	284	1,390	6.88	7.93
April	1,430	142	396	1.96	2.19
May	3,390	103	511	2.53	2.92
June	6,920	32	678	3.36	3.75
July	633	16	109	.540	.62
August	447	22	101	.500	.58
September	412	10	78.2	.387	.43
The year	13,400	8.1	524	2.59	35.13

LITTLE BEAVER RIVER BASIN.

LITTLE BEAVER RIVER NEAR EAST LIVERPOOL, OHIO.

LOCATION.—At steel highway bridge known as Grimms Bridge, about 4 miles above mouth of river and about 4 miles northeast of East Liverpool, Columbiana County. North Fork enters river on left about 3 miles above station.

DRAINAGE AREA.—505 square miles (measured on topographic maps).

RECORDS AVAILABLE.—May 17, 1915, to September 30, 1917.

GAGE.—Chain gage fastened to downstream side of highway bridge; read by C. W. Garn.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—One channel at all stages; at extremely high stages water flows around both bridge abutments. Channel straight for 100 feet above and 300 feet below station. Rapids about 600 feet below bridge act as primary control, probably permanent. Point of zero flow, gage height, 0.1±0.2 foot.

EXTREMES OF STAGE.—Maximum stage recorded during year, 9.25 feet at 5.00 p. m. January 5; minimum stage, 2.07 feet at 7 a. m. September 26. Highest known flood reached a stage represented by gage height about 20 feet.

ICE.—Stage-discharge relation affected by ice and by ice jams.

ACCURACY.—Stage-discharge relation probably permanent; affected by ice December 14–26, January 12–21, and February 2 to March 1. Data inadequate for determining rating curve. Gage read twice daily to hundredths. Records excellent.

COOPERATION.—Station maintained in cooperation with United States Engineer Corps.

Daily gage height, in feet, of Little Beaver River near East Liverpool, Ohio, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.14	2.39	3.39	3.62	6.08	3.94	3.86	2.24	5.44	3.50	2.88	2.42
2	2.12	2.39	3.25	3.64	4.85	3.70	3.89	3.18	4.80	3.78	2.74	2.40
3	2.19	2.38	3.12	4.10	5.13	3.59	3.90	3.05	4.31	3.50	2.66	2.46
4	2.11	2.48	3.05	4.44	5.15	3.72	3.69	3.25	3.88	3.20	2.57	2.31
5	2.10	2.76	3.12	7.52	4.82	4.31	3.99	4.94	3.72	3.01	2.50	2.26
6	2.08	2.60	3.06	7.93	4.70	4.54	5.82	4.34	5.19	2.92	2.46	2.73
7	2.10	2.54	2.93	6.08	4.68	4.04	6.15	4.06	6.12	2.84	2.68	2.66
8	2.07	2.50	2.88	5.12	4.55	5.50	5.50	3.96	5.50	2.79	3.10	3.40
9	2.10	2.47	2.88	4.63	4.29	5.27	4.70	3.54	5.10	2.80	2.53	3.08
10	2.16	2.64	2.93	4.62	4.16	4.88	4.28	3.56	6.58	4.06	2.50	3.80
11	2.18	2.75	2.92	3.91	4.48	6.89	4.12	3.46	6.23	3.54	2.46	2.60
12	2.14	2.68	2.96	5.38	....	7.48	3.96	3.30	5.10	3.24	2.40	2.47
13	2.18	2.58	3.12	5.25	3.26	6.00	3.80	3.25	4.38	3.52	2.38	2.40
14	2.44	2.74	2.95	4.96	....	5.64	3.68	3.23	4.02	3.69	2.84	2.34
15	2.38	2.98	3.05	4.80	....	5.36	3.58	3.12	3.95	3.43	2.82	2.28
16	2.40	2.92	2.85	5.00	3.48	4.85	3.56	3.05	3.76	3.18	2.74	2.31
17	2.36	2.80	2.86	4.84	3.52	4.73	3.42	3.00	3.56	4.10	2.50	2.26
18	2.29	2.69	2.74	4.73	3.92	4.65	3.36	2.99	3.38	4.40	2.39	2.20
19	3.35	2.66	2.79	4.70	4.00	4.28	3.88	3.61	3.28	3.82	2.33	2.19
20	3.67	2.58	2.79	4.70	4.81	4.24	3.74	3.36	3.23	3.40	2.26	2.20
21	3.36	2.55	2.82	4.38	4.44	4.18	3.55	3.27	3.10	3.16	2.20	2.20
22	2.98	2.52	3.12	6.90	4.10	4.22	3.43	3.86	2.98	2.96	2.22	2.14
23	2.74	2.64	3.45	5.54	4.34	4.18	3.32	4.22	3.04	2.84	2.86	2.10
24	2.62	3.40	3.45	4.92	5.56	7.09	3.26	3.94	3.81	2.89	3.22	2.08
25	2.51	3.32	3.50	4.61	5.08	5.98	3.24	3.63	3.45	2.93	2.83	2.12
26	2.48	3.44	....	4.10	4.55	5.65	3.48	3.42	3.13	3.34	2.60	2.09
27	2.44	3.22	6.15	3.62	6.89	4.71	3.38	3.34	4.30	6.24	2.48	2.09
28	2.42	2.98	6.84	3.98	4.92	4.53	3.26	3.38	3.44	4.38	2.40	2.16
29	2.37	3.72	5.48	4.44	....	4.38	3.16	4.02	5.29	3.66	2.32	2.18
30	2.35	3.58	4.44	7.02	....	4.20	3.15	3.86	2.94	3.26	2.36	2.13
31	2.36	....	3.38	6.22	....	3.98	....	3.52	....	3.08	2.39	....

YELLOW CREEK BASIN.

YELLOW CREEK AT HAMMONDSVILLE, OHIO.

LOCATION.—At covered highway bridge on Steubenville pike about one-fifth mile southwest of Hammondsville, Jefferson County. North Fork enters on left 1,000 feet below station.

DRAINAGE AREA.—169 square miles (measured on topographic maps).

RECORDS AVAILABLE.—May 13, 1915, to September 30, 1917.

GAGE.—Chain gage on downstream side of bridge about 25 feet from left end; read by W. J. Sprague.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—One channel, but at extreme high stages, stream flows around both abutments; straight 1,000 feet above and curved 100 feet below station. Control practically permanent. Point of zero flow, gage height about 1.4 feet September, 1915, and 1916, and October, 1917.

EXTREMES OF STAGE.—Maximum stage recorded during year, 8.63 feet at 4.30 p. m. January 5; minimum stage recorded 1.80 feet at 5 p. m. October 8.

Highest known flood reached a stage represented by gage height about 16 feet.

ICE.—Stage-discharge relation affected by ice during severe winters.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice December 18-27 and February 2-27. Data inadequate for determining rating curve. Gage read twice daily to hundredths. Records excellent.

COOPERATION.—Station maintained in cooperation with United States Engineer Corps.

Daily gage height, in feet, of Yellow Creek at Hammondsville, Ohio, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.02	2.04	3.16	3.08	4.72	3.40	3.38	2.84	4.38	3.29	2.55	2.39
2	1.96	2.03	2.86	3.08	4.57	3.23	3.38	2.76	3.74	4.56	2.47	2.34
3	1.94	2.01	2.74	3.52	5.41	3.14	3.31	2.70	3.72	3.64	2.42	2.51
4	1.91	2.50	2.72	3.48	5.92	3.20	3.16	3.28	3.38	3.10	2.37	2.34
5	1.90	2.44	2.76	3.02	5.94	3.22	3.62	4.01	3.24	2.70	2.33	2.20
6	1.88	2.35	2.72	5.36	....	3.20	5.20	3.77	4.36	2.46	2.30	2.40
7	1.85	2.26	2.64	4.81	....	3.32	4.90	3.52	4.33	3.17	[illegible].28	2.36
8	1.82	2.18	2.58	4.26	....	4.60	4.40	3.33	3.88	2.88	2.32	2.58
9	1.90	2.16	2.68	3.72	5.80	4.20	4.15	3.19	3.56	2.79	2.53	2.87
10	1.88	2.42	2.64	3.40	....	4.12	3.90	3.08	4.92	2.93	2.44	2.55
11	1.86	2.38	2.55	3.24	....	5.45	3.62	2.94	4.50	2.75	2.34	2.37
12	1.82	2.33	2.46	3.09	5.41	6.89	3.50	2.84	4.19	2.68	2.30	2.30
13	2.02	2.48	2.38	3.17	4.80	6.00	3.32	2.78	3.66	2.66	2.22	2.28
14	2.02	2.69	2.40	2.97	3.85	4.91	3.24	2.70	3.26	3.00	2.34	2.26
15	1.98	2.62	2.41	2.98	3.68	4.90	3.16	2.62	3.17	2.80	2.62	2.24
16	2.04	2.46	2.38	3.13	3.68	4.52	3.07	2.59	3.13	2.68	2.37	2.24
17	2.01	2.34	2.34	3.19	3.85	4.26	2.98	2.58	2.92	2.73	2.27	2.19
18	1.98	2.27	2.33	3.20	3.99	4.16	2.91	2.78	2.82	4.70	2.20	2.16
19	2.74	2.22	2.32	3.07	4.09	3.88	3.10	2.72	2.76	3.58	2.12	2.15
20	2.90	2.16	....	2.96	4.08	3.78	3.01	3.01	2.70	3.14	2.12	2.14
21	2.68	2.14	....	2.94	4.14	3.64	2.94	2.96	2.65	2.91	2.16	2.14
22	2.42	2.13	2.35	7.86	4.15	3.53	2.91	3.00	2.58	2.74	2.40	2.12
23	2.28	2.10	2.54	4.98	4.28	3.41	2.86	3.21	2.60	2.96	2.64	2.10
24	2.22	2.42	2.86	4.52	6.05	5.44	2.82	3.26	3.80	2.85	3.28	2.09
25	2.18	2.82	2.67	4.04	5.25	4.58	2.75	3.23	3.09	3.00	2.78	2.08
26	2.14	2.62	4.44	3.50	5.14	4.28	3.04	3.13	2.66	4.17	2.50	2.06
27	2.12	2.39	5.58	2.98	5.08	4.08	2.94	2.98	3.36	3.68	2.39	2.06
28	2.10	2.50	4.79	3.67	3.69	3.90	2.88	2.82	3.00	3.11	2.33	2.09
29	2.06	3.66	4.09	3.94	....	3.84	2.84	3.23	4.70	2.86	2.29	2.08
30	2.03	3.88	3.52	5.04	....	3.62	2.90	3.12	3.82	2.73	2.32	2.08
31	2.03	....	3.20	4.64	....	3.48	....	3.01	....	2.64	2.40	....

MIDDLE ISLAND CREEK BASIN.

MIDDLE ISLAND CREEK AT LITTLE, W. VA.

Location.—At highway bridge at Little, about 6 miles southeast of Friendly, Tyler County. Stewart Run enters on left about 500 feet below station.

Drainage area.—458 square miles (measured on topographic maps).

Records available.—May 7, 1915, to September 30, 1917.

Gage.—Vertical and inclined staff on left bank immediately below the bridge; read by J. R. Bowles.

Discharge measurements.—Made from bridge or by wading. Stay wire is used for measurements at high stages.

Channel and control.—One channel at all stages; straight for about 400 feet above and 250 feet below station. Primary control is at foundation of old mill dam 250 feet below station; composed of bed rock, foundation timbers, small deposit of rock and sand; probably permanent. Point of zero flow, gage height 1.4 feet ± 0.2 foot.

Extremes of stage.—Maximum stage recorded during year, 22.22 feet at 5 p. m. January 22; minimum stage, 1.90 feet at 6 p. m. August 22.

Highest flood known occurred in August, 1875; gage height about 33.5 feet.

Ice.—Stage-discharge relation affected by ice during winter months.

Accuracy.—Stage-discharge relation practically permanent; affected by ice February 3–18. Gage not checked since August, 1916; therefore record of daily discharge is withheld. Gage read twice daily to hundredths.

Cooperation.—Base data furnished by United States Engineer Corps.

Discharge measurements of Middle Island Creek at Little, W. Va., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Oct. 20	L. C. Leasure	5.82	2,210
Dec. 27	United States Army Engineers	10.45	5,710
Jan. 22	.....do	22.20	18,200

Daily gage height, in feet, of Middle Island Creek at Little, W. Va., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.28	2.33	3.10	3.34	4.18	6.02	2.95	3.50	4.28	2.60	2.54	7.43
2	2.20	2.31	3.07	3.29	3.66	5.02	2.92	3.27	6.57	2.56	2.44	3.90
3	2.15	2.29	2.97	6.42	3.20	5.56	2.96	3.01	5.39	2.38	2.35	3.19
4	2.13	2.27	2.85	7.50	3.30	5.50	2.90	2.95	4.00	2.34	2.27	3.19
5	2.09	2.25	3.15	6.47	3.36	5.04	3.08	3.14	3.24	2.29	2.19	3.23
6	2.05	2.27	3.17	7.28	3.18	4.04	13.37	3.08	3.46	2.23	2.14	3.24
7	2.03	2.25	3.05	4.67	2.93	5.04	10.34	2.95	3.62	2.18	2.12	3.40
8	2.00	2.21	2.91	3.63	2.97	12.04	5.63	2.86	3.51	2.17	2.12	3.48
9	2.09	2.19	2.87	3.50	2.98	9.50	4.43	2.81	4.31	2.13	2.10	3.17
10	2.08	2.25	2.89	3.38	3.06	6.02	3.87	2.75	7.52	2.12	2.04	2.93
11	2.16	2.87	2.86	3.38	3.02	7.50	3.55	2.71	5.33	2.39	2.02	2.73
12	2.31	2.77	2.89	3.37	2.92	9.00	3.38	2.65	3.96	2.21	2.00	2.59
13	2.29	2.73	2.87	3.36	2.81	8.50	3.23	2.59	3.44	2.12	1.99	2.46
14	2.23	2.73	2.87	3.36	2.66	8.50	3.12	2.55	3.17	2.28	2.18	2.35
15	2.17	2.80	2.75	3.34	2.62	6.04	3.03	2.52	2.99	3.24	2.52	2.29
16	2.22	2.83	2.65	3.34	2.68	4.08	2.94	2.49	2.86	4.94	2.33	2.20
17	2.85	2.74	2.64	3.34	2.72	4.05	2.85	2.45	2.76	4.14	2.17	2.25
18	2.43	2.69	2.61	3.33	3.00	4.53	2.82	2.40	2.68	3.39	2.09	2.25
19	5.54	2.63	2.60	3.34	3.34	4.00	2.87	2.37	2.60	3.16	2.02	2.20
20	5.22	2.55	2.57	3.34	3.76	3.36	2.85	2.34	2.56	3.20	1.98	2.15
21	4.27	2.49	2.77	3.78	3.70	3.60	2.79	2.30	2.44	3.06	1.93	2.00
22	3.67	2.47	7.49	21.61	3.46	2.71	2.74	2.27	2.40	2.75	2.44	2.00
23	3.53	2.49	5.28	8.24	3.56	3.57	2.69	2.27	2.39	3.12	5.13	2.00
24	2.97	3.22	3.89	4.24	7.22	8.32	2.68	3.11	2.41	3.58	4.36	2.00
25	2.85	4.02	3.65	3.86	4.90	5.84	2.69	2.87	2.38	2.81	3.66	2.00
26	2.73	3.44	3.40	5.41	4.01	4.38	2.95	2.69	2.33	3.53	3.32	2.00
27	2.65	3.14	8.43	3.92	3.74	3.70	2.97	7.17	2.29	4.50	2.91	2.00
28	2.57	3.07	9.66	4.20	5.50	3.50	3.20	14.08	2.32	3.57	2.54	2.00
29	2.50	3.08	7.76	6.44	....	3.31	3.59	10.44	2.31	3.21	2.41	2.00
30	2.43	3.11	4.57	6.50	....	3.18	3.80	5.32	2.30	2.91	2.69	2.00
31	2.37	....	3.68	4.58	....	3.04	....	3.91	....	2.71	2.65	....

LITTLE MUSKINGUM RIVER BASIN.

LITTLE MUSKINGUM RIVER AT FAY, OHIO.

Location.—About a mile northwest of Fay, Washington County, Ohio, 7 miles from St. Marys, W. Va., and 12 miles from Marietta, Ohio. Bear Run enters on left about half a mile above station. Covered highway bridge crosses river just above Bear Run.

Drainage area.—259 square miles (measured on topographic maps).

Records available.—May 14, 1915, to September 30, 1917.

Gage.—Inclined and vertical staff on right bank about 400 feet below suspension footbridge; read by G. I. Smith.

Discharge measurements.—Made from suspension bridge or by wading.

Channel and control.—One channel at all stages; straight several hundred feet above and below bridge. Overflow at gage height about 13 feet; wide overflow at maximum stages. Bed of stream mud, sand, rock, and gravel; primary control at ford 50 feet below gage compact sand and gravel; fairly permanent. Point of zero flow, gage height 0.7±0.2 foot May, 1915.

EXTREMES OF STAGE.—Maximum stage recorded during the year, 21.5 feet at 5 p. m. January 22; minimum stage, 1.19 feet at 8 a. m. September 27.

Highest flood known reached a stage represented by gage height about 23 feet.

ICE.—Stage-discharge relation affected by ice in severe winters.

ACCURACY.—Stage-discharge relation probably permanent; probably affected to some extent by ice. Data inadequate for determining rating curve. Gage read twice daily to hundredths. Records excellent.

COOPERATION.—Base data furnished by United States Engineer Corps.

Discharge measurements of Little Muskingum River at Fay, Ohio, during the year ending Sept. 30, 1917.

[Made by U. S. Army Engineers.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 28	10.33	3,490	Dec. 28	11.00	3,500	Dec. 28	12.90	2,670
28	10.45	3,260	28	12.05	2,840	Apr. 7	6.77	1,570
28	10.55	3,090	28	12.40	2,600	7	6.95	1,600

Daily gage height, in feet, of Little Muskingum River at Fay, Ohio, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.35	1.54	2.97	3.01	4.09	3.53	2.49	3.14	6.04	1.96	1.52	2.65
2	1.34	1.45	2.61	2.84	3.44	3.47	2.70	3.09	7.12	1.78	1.46	2.24
3	1.32	1.41	2.38	6.04	2.75	3.43	2.58	2.78	5.69	1.86	1.41	2.47
4	1.29	1.38	2.23	4.79	3.13	4.02	1.84	2.68	3.77	1.82	1.35	2.26
5	1.25	1.41	2.50	7.95	2.85	4.20	4 44	2.77	3.18	1.67	1.35	2.03
6	1.23	1.43	2.95	8.20	2.65	3.47	18.15	2.71	3.81	1.55	1.31	1.90
7	1.23	1.36	2.57	......	2.39	4.17	9.39	2.58	4.61	1.46	1.75	1.79
8	1.21	1.33	2.39	3.54	2.33	10.60	4.75	2.49	4.18	1.48	2.14	2.53
9	1.24	1.41	2.40	3.21	2.53	6.77	3.71	2.42	4.75	1.42	2.26	2.80
10	1.23	1.59	2.64	3.08	2.60	4.99	3.41	2.32	7.60	1.59	2.07	2.30
11	1.25	1.53	2.61	2.85	2.29	8.65	3.13	2.23	5.70	2.52	1.73	1.98
12	1.27	1.51	2.61	2.42	2.20	7.20	2.96	2.14	3.81	1.93	1.55	1.79
13	1.23	1.57	2.49	2.32	1.94	7.30	2.84	2.10	3.19	1.73	1.43	1.69
14	1.25	1.61	2.39	2.45	1.78	12.70	2.68	2.07	3.07	3.40	1.50	1.55
15	1.25	1.77	2.20	3.29	1.81	5.20	2.58	1.99	2.76	4.55	3.25	1.50
16	1.37	1.83	2.11	3.05	1.93	4.05	2.45	1.90	2.54	3.46	2.28	1.48
17	1.44	1.79	2.03	2.76	1.90	3.70	2.36	1.85	2.26	4.04	1.81	1.44
18	1.42	1.73	1.99	2.55	1.96	3.67	2.33	1.81	2.09	4.59	1.61	1.36
19	3.57	1.66	1.86	2.55	2.46	3.34	2.32	1.75	2.07	3.37	1.50	1.38
20	3.74	1.61	1.87	2.43	2.67	3.17	2.25	1.67	2.05	2.71	1.41	1.29
21	3.26	1.57	2.54	3.41	2.69	3.43	2.18	1.66	1.95	2.30	1.36	1.29
22	2.59	1.57	8.55	19.75	2.48	3.85	2.12	1.67	1.86	......	1.57	1.31
23	2.27	1.65	4.83	6.80	3.73	3.53	2.05	1.69	1.96	2.44	3.92	1.25
24	2.00	2.83	3.57	3.85	8.20	10.00	2.04	1.71	1.92	2.02	3.49	1.22
25	1.85	3.00	3.33	3.32	4.16	4.80	2.11	1.75	1.87	1.86	2.57	1.21
26	1.75	2.47	3.10	3.04	3.54	3.77	4.70	1.64	1.74	2.46	2.07	1.20
27	1.65	2.26	12.80	2.73	3.58	3.34	3.46	4.60	1.68	3.04	1.85	1.20
28	1.60	2.18	12.27	3.85	3.67	3.14	3.33	8.15	1.65	2.34	1.71	1.23
29	1.57	2.95	5.58	6.33	......	2.87	3.36	6.68	2.67	1.92	1.64	1.26
30	1.51	3.63	3.69	8.35	......	2.74	3.20	3.75	2.30	1.74	1.88	1.23
31	1.48	......	3.09	4.60	......	2.59	......	3.09	......	1.62	3.36	......

MUSKINGUM RIVER BASIN.

MUSKINGUM RIVER AT FRAZIER, OHIO.

LOCATION.—At highway bridge at Frazier, Muskingum County, 4½ miles below Zanesville. Brush Creek enters on right about one-third mile below the gage.

DRAINAGE AREA.—6,980 square miles (United States Engineer Corps).

RECORDS AVAILABLE.—June 1, 1915, to September 30, 1917.

GAGE.—Staff near upper corner of right abutment of bridge; read by D. A. Burns. Sea-level elevation of zero of gage, 663.29 feet.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge or by wading on crest of dam No. 9, about 5½ miles below gage. Leakage past dam, through lock and power plants, should be included with flow over crest.

CHANNEL AND CONTROL.—River straight above and below. Control is crest of dam No. 9, about 5½ miles below gage. Except for leakage through lock and dam and leakage and flow through power plants at the dam, the gage height of the crest of the dam, 9.0 feet, is the point at which flow would be zero.

EXTREMES OF STAGE.—Maximum mean daily stage recorded during year, 18.25 feet March 14; minimum stage, 9.3 feet September 21–30.

Flood of March, 1913, reached a stage of 49.1 feet; highest stage ever recorded.

ICE.—Stage-discharge relation affected by ice jams at times.

REGULATION.—Leakage through the lock and the power plants at dam No. 9 and the operation of power plants at dams Nos. 9 and 10 may affect the low-water flow to some extent.

ACCURACY.—Stage-discharge relation permanent, except as the relation may be affected by leakage through dam No. 9, through the gates of the power plants and through the lock, and by the operation of the power plants at dam No. 9; probably not affected by ice. The flow from the area between the measuring section and the crest of dam No. 9 may be sufficient at times to affect the stage-discharge relation. This area, however, is small, and such conditions would be of rare occurrence and of small effect. Gage read twice daily to tenths. Records good.

COOPERATION.—Base data furnished by the United States Engineer Corps.

Discharge measurements of Muskingum River at Frazier, Ohio, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 12	H. E. Frye	9.6	672	Apr. 6	W. H. Dial	17.00	34,300
Mar. 24	W. H. Dial	15.18	26,300	7	.....do	18.11	39,400
26	.....do	14.59	21,300	23	Dial and Moesser	10.31	4,070

Daily gage height, in feet, of Muskingum River at Frazier, Ohio, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	9.6	9.6	10.5	12.2	15.45	11.95	11.1	10.56	10.9	11.95	9.7	9.5
2	9.6	9.6	10.5	11.45	14.6	11.45	11.15	10.6	11.4	11.6	9.7	9.5
3	9.6	9.6	10.4	11.0	13.2	11.3	11.75	10.4	11.2	10.9	9.7	9.4
4	9.5	9.6	10.4	11.0	12.3	11.15	11.95	10.4	10.95	10.55	9.6	9.6
5	9.5	9.6	10.4	13.7	11.75	10.9	11.95	10.85	10.65	10.2	9.6	9.75
6	9.5	9.7	10.0	18.15	11.1	10.7	17.0	11.5	10.5	10.0	9.5	9.7
7	9.5	9.9	10.0	17.25	10.75	10.6	18.05	11.65	11.2	10.0	9.5	9.65
8	9.5	9.8	10.1	16.6	10.55	11.3	17.35	11.4	12.1	11.0	9.5	9.5
9	9.5	9.8	9.95	15.6	10.45	12.0	16.6	11.25	11.65	10.7	9.4	9.5
10	9.5	9.8	9.8	14.35	10.35	12.75	15.5	10.85	11.3	11.15	9.45	9.7
11	9.6	9.7	9.8	13.35	9.95	13.1	13.75	10.65	11.3	10.6	9.5	9.7
12	9.6	9.7	9.75	11.8	9.85	14.3	12.7	10.45	11.95	10.45	9.5	9.7
13	9.6	9.7	9.7	11.45	9.7	15.45	12.0	10.4	12.1	10.3	9.5	9.5
14	9.6	9.8	9.7	10.95	9.55	18.25	11.55	10.4	11.3	12.15	9.5	9.5
15	9.6	9.8	9.7	10.85	9.45	17.45	11.45	10.3	10.7	12.3	9.7	9.5
16	9.6	9.8	9.6	10.75	9.35	16.2	11.15	10.25	10.5	11.45	9.9	9.4
17	9.6	9.8	9.6	10.45	9.25	15.4	10.95	10.0	10.4	11.4	9.8	9.4
18	9.6	9.8	9.6	10.3	9.15	14.55	10.85	10.0	10.3	13.1	9.65	9.4
19	9.5	9.8	9.6	10.0	9.05	13.5	10.8	9.9	10.1	13.21	9.5	9.4
20	9.5	9.8	9.6	9.9	9.35	12.2	10.7	9.9	10.1	12.5	9.5	9.4
21	9.4	9.8	9.6	9.8	11.2	12.05	10.7	9.8	10.0	11.75	9.5	9.3
22	9.4	9.8	9.7	14.35	11.7	11.7	10.45	9.9	9.9	11.2	9.4	9.3
23	9.9	9.8	9.7	15.05	11.9	11.6	10.4	10.0	10.15	10.85	9.4	9.3
24	9.8	9.9	9.6	14.0	12.65	14.6	10.45	10.0	10.1	10.4	9.6	9.3
25	9.7	9.9	9.9	13.75	13.05	15.2	10.5	10.2	10.2	10.2	9.6	9.3
26	9.6	10.4	10.3	13.5	12.9	14.6	10.4	10.1	10.3	10.2	9.55	9.3
27	9.6	10.3	12.25	12.6	12.65	13.65	10.3	10.0	10.3	10.1	9.6	9.3
28	9.6	10.3	13.9	12.55	12.55	12.65	10.6	10.1	10.4	10.0	9.55	9.3
29	9.6	10.3	14.2	12.45	....	11.9	10.45	10.5	11.0	10.0	9.45	9.3
30	9.6	10.4	13.75	13.75	....	11.55	10.4	10.75	12.05	9.9	9.45	9.3
31	9.6	....	13.35	14.75	....	11.35	....	10.95	....	9.85	9.45	....

MUSKINGUM RIVER AT BEVERLY, OHIO.

LOCATION.—At Lock 4 at Beverly, Washington County. Wolf Creek enters on right immediately above station.

DRAINAGE AREA.—7,700 square miles (United States Engineer Corps).

RECORDS AVAILABLE.—June 1, 1915, to September 30, 1917.

GAGE.—Ceramic tile gage, graduated to tenths of a foot, on lower buttress of river wall of Lock 4, about 1,000 feet above the measuring section. Sea-level elevation of zero of gage, 602.60 feet (United States Engineer Corps).

DISCHARGE MEASUREMENTS.—Made from upstream side of highway bridge 1,000 feet below gage.

CHANNEL AND CONTROL.—Bed of stream gravel and masonry débris of old bridge piers; probably permanent. Stream curves slightly to the left from 1,000 feet above to 1,000 feet below the section. Control is crest of dam No. 3, 10.8 miles below. At gage height 5.2 feet or crest of dam No. 3, flow would be zero provided there was no leakage through dam, lock, or power plant at dam.

EXTREMES OF STAGE.—Maximum mean daily stage recorded during year, 20.3 feet April 6; minimum stage, 3.0 feet October 1–13.

Flood of March, 1913, reached a stage of 46.55, the highest stage ever recorded.

ICE.—Stage-discharge relation not affected by ice.

REGULATION.—Leakage through dam No. 3, lock, and the power plant at the dam may affect the low-water flow to some extent.

ACCURACY.—Stage-discharge relation practically permanent; not affected by ice. Dam No. 3, about 11 miles below, the control for the gage, leaks so that the water falls below the crest during low water. Change in this leakage, leakage and flow through the power plant, leakage through lock, and inflow into pool 3 below the measuring section may all affect the stage-discharge relation at low and medium stages. When the stage of the Ohio at Marietta is about 39 feet or more, the stage-discharge relation is affected by backwater. Records of daily discharge withheld for additional information. Gage read twice daily to tenths. Records good, except as may be affected by described conditions at low and medium stages.

COOPERATION.—Base data furnished by United States Engineer Corps.

Daily gage height, in feet, of Muskingum River at Beverly for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	3.0	5.1	6.1	16.25	14.95	10.15	8.35	7.0	9.6	9.9	6.0	5.05
2	3.0	5.1	6.4	8.7	14.15	9.2	8.4	6.9	9.35	9.65	5.85	4.85
3	3.0	5.1	6.35	8.65	11.95	8.6	9.0	6.9	9.6	8.6	5.7	5.4
4	3.0	5.1	6.15	8.35	10.0	8.5	9.7	6.9	8.2	7.55	5.6	5.5
5	3.0	5.1	6.15	12.7	9.05	8.25	10.15	7.2	7.75	6.95	5.6	5.6
6	3.0	5.4	6.1	18.4	8.75	7.85	20.3	7.9	7.5	6.5	5.5	5.7
7	3.0	5.8	6.1	17.7	8.55	7.7	19.1	8.9	7.5	6.3	5.75	5.6
8	3.0	5.85	6.35	16.35	9.05	9.5	18.0	8.45	9.85	7.6	5.6	5.5
9	3.0	5.65	6.35	15.45	9.2	10.2	16.9	7.85	9.6	7.55	5.5	5.4
10	3.0	5.5	6.1	13.4	8.95	11.15	15.5	7.5	8.9	8.2	5.45	5.3
11	3.0	5.5	5.95	12.05	8.3	12.65	13.6	7.3	8.8	7.8	5.25	5.4
12	3.0	5.5	5.8	10.05	8.0	13.75	11.8	7.15	9.2	7.1	5.2	5.4
13	3.0	5.5	5.8	8.45	7.95	16.2	10.1	6.9	9.95	6.8	5.2	5.2
14	3.25	5.5	5.7	7.45	7.7	19.35	9.15	6.8	9.25	9.1	5.45	4.7
15	3.45	5.5	5.55	7.65	7.5	18.2	8.5	6.7	8.0	11.6	5.6	4.35
16	3.5	5.5	5.5	7.65	7.45	16.35	8.2	6.55	7.35	9.4	5.95	4.2
17	3.5	5.5	5.4	7.5	7.25	15.25	7.95	6.5	7.05	9.5	5.7	3.85
18	3.5	5.5	5.4	7.75	7.25	14.0	7.65	6.4	6.85	11.95	5.4	3.6
19	4.05	5.5	5.4	7.8	7.4	12.4	7.45	6.3	6.7	12.3	5.4	3.5
20	4.95	5.5	5.4	7.7	7.75	10.75	7.4	6.25	6.6	10.95	5.25	3.5
21	5.45	5.5	5.5	7.8	8.35	10.0	7.35	6.2	6.5	9.9	5.1	3.4
22	5.6	5.4	6.4	16.4	9.0	9.55	7.2	6.25	6.4	9.05	5.15	3.4
23	6.0	5.4	6.05	15.0	9.75	9.3	7.1	6.45	6.8	8.35	5.05	3.4
24	5.85	5.55	5.85	13.1	12.45	14.35	7.0	6.35	6.6	7.35	5.5	3.3
25	5.7	5.65	6.15	12.45	11.35	14.45	7.0	6.45	6.6	6.8	5.5	3.3
26	5.55	6.2	6.8	11.85	11.25	13.8	7.0	6.5	6.85	6.7	5.4	3.3
27	5.4	6.5	11.3	11.3	11.0	12.6	7.0	7.75	6.65	6.7	5.35	3.3
28	5.3	6.25	13.2	11.45	10.9	11.4	7.35	9.05	7.35	6.55	5.3	3.35
29	5.2	6.0	12.95	11.75	....	10.0	7.45	8.15	9.7	6.35	5.15	3.4
30	5.1	5.9	12.15	12.95	....	9.25	7.05	7.55	10.15	6.1	5.2	3.4
31	5.1	....	11.55	13.65	....	8.65	....	7.7	....	6.0	5.2	....

LITTLE KANAWHA RIVER BASIN.

LITTLE KANAWHA RIVER AT GLENVILLE, W. VA.

Location.—At three-span steel highway bridge at Glenville, Gilmer County. Stewart Creek enters on right about 1½ miles above station.

Drainage area.—385 square miles (measured on topographic maps).

Records available.—June 1, 1915, to September 30, 1917.

Gage.—Vertical and inclined staff attached to upstream side of right pier of bridge; read by Hollie Gainor. Gage was established by the United States Weather Bureau September 10, 1900 (read daily to tenths at 8 a. m.), repaired and its datum lowered 2.5 feet on June 1, 1915.

Discharge measurements.—Made from bridge or by wading.

Channel and control.—One channel at all stages; straight for 100 feet above and 150 feet below station. Bed of river composed of mud, rock, sand, and gravel; control is probably fairly permanent. Point of zero flow, gage height about 1.0 foot June and September, 1915.

Extremes of stage.—Maximum stage recorded during year, 28.3 feet at 7.15 a. m. January 22; minimum stage, 1.50 feet September 21 and 27.

Highest flood known reached a stage represented by gage height about 29 feet, referred to present datum.

Ice.—Stage-discharge relation affected by ice during severe winters.

Accuracy.—Stage-discharge relation probably permanent; probably not affected by ice. Data inadequate for determining rating curve. Gage read twice daily to hundredths. Records excellent.

Cooperation.—Base data furnished by United States Engineer Corps.

Discharge measurements of Little Kanawha River at Glenville, W. Va., during the year ending Sept. 30, 1917.

[Made by F. Conklin.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Dec. 22	13.95	5,620
23	9.41	3,060
23	7.42	2,270

Daily gage height, in feet, of Little Kanawha River at Glenville, W. Va., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	4.07	2.50	4.00	4.10	4.53	10.47	3.77	4.07	5.10	2.80	2.60	3.45
2	3.67	2.43	3.70	4.05	4.25	7.10	3.62	3.85	6.37	2.70	2.42	3.17
3	3.10	2.37	3.45	8.35	3.97	11.35	3.47	3.72	6.85	2.40	2.27	3.02
4	2.80	2.30	3.33	6.53	3.93	12.45	3.32	3.62	4.72	2.23	2.17	2.85
5	2.57	2.25	5.65	6.15	3.83	12.35	3.35	3.47	4.37	2.12	2.07	2.72
6	2.35	2.17	5.10	8.83	3.67	7.20	10.75	3.37	4.02	2.02	1.97	2.62
7	2.23	2.15	4.35	6.40	3.63	7.15	10.25	3.30	4.55	1.90	4.02	2.52
8	2.43	2.13	4.17	4.90	3.77	19.00	6.70	3.45	4.52	1.82	3.05	2.42
9	2.37	2.17	4.10	4.40	3.73	14.00	5.75	3.42	4.87	1.82	4.15	2.37
10	2.60	2.35	3.97	4.15	3.58	6.35	4.52	3.32	6.27	2.85	3.32	2.27
11	2.95	2.47	3.87	4.15	3.43	7.45	4.27	3.37	5.72	2.37	2.55	2.17
12	2.87	2.67	3.90	3.93	3.27	25.45	4.07	3.47	4.60	2.22	2.35	2.07
13	2.73	2.67	3.80	3.83	3.13	16.08	3.97	3.45	4.07	2.12	2.20	1.97
14	2.63	2.67	3.53	5.00	3.10	15.48	3.90	3.37	3.80	2.17	2.07	1.95
15	2.57	2.60	3.25	4.55	3.17	7.80	3.77	3.27	3.57	2.32	1.92	1.77
16	2.63	2.55	3.05	4.70	3.13	5.60	3.62	3.17	3.35	2.40	1.82	1.67
17	2.70	2.50	3.13	4.55	3.47	6.95	3.52	3.07	3.15	2.47	1.72	1.67
18	2.13	2.45	3.30	4.20	5.35	5.95	3.47	2.95	2.92	2.77	1.62	1.63
19	5.77	2.53	3.27	4.13	5.55	4.90	3.37	2.77	2.75	3.97	1.62	1.62
20	5.05	2.47	3.23	4.13	5.45	4.65	3.27	2.70	2.57	3.47	1.62	1.57
21	4.90	2.53	8.10	8.10	5.23	4.88	3.20	3.50	2.47	3.22	1.57	1.52
22	4.10	2.53	12.15	27.15	4.57	5.75	3.12	3.47	2.40	3.12	1.70	1.57
23	3.67	2.63	8.45	9.35	5.93	5.30	3.02	3.67	2.35	3.02	2.07	1.63
24	3.50	4.93	5.15	5.17	14.15	7.70	2.97	3.45	2.27	3.02	1.95	1.57
25	3.27	4.80	4.15	4.65	8.10	6.00	2.97	3.26	2.22	3.27	1.82	1.62
26	3.05	4.23	4.07	4.23	5.70	5.05	2.95	3.05	2.17	4.32	1.67	1.57
27	2.83	3.93	4.87	4.03	7.10	4.60	2.92	17.37	2.17	4.02	1.57	1.52
28	2.73	3.77	13.25	4.73	10.65	4.48	2.97	21.02	2.27	3.82	1.57	1.72
29	2.57	3.63	9.57	5.03	......	4.25	3.27	17.05	2.85	3.55	1.60	1.65
30	2.47	4.40	5.55	5.25	......	4.05	4.50	9.20	2.82	3.17	1.67	1.60
31	2.43	......	4.15	4.60	......	3.88	......	5.42	......	2.87	2.17	......

LITTLE KANAWHA RIVER AT LOCK 4, PALESTINE, W. VA.

Location.—At Lock 4, Palestine, Wirt County, 30 miles from Parkersburg via Little Kanawha Railroad. Reedy Creek enters on left 1 mile above gage.

Drainage area.—1,500 square miles (measured on map of West Virginia, scale 1:500,000).

Records available.—April 25, 1915, to September 30, 1917. The upper and lower gages at the lock have been read under the direction of the Corps of Engineers, United States Army, as follows: November 5, 1905, to July 14, 1906; September 1-30, 1906; October 25, 1906, to date.

Gage.—Upper gage at lock; vertical staff on right bank bolted to right side of river wall of lock just above upper gates; an inclined section of gage extends above top of lock wall; read by James Burton, lockmaster.

Discharge measurements.—Made at cable about 1,200 feet below gage or by wading on crest of dam.

Channel and control.—One channel at all stages. Crest of dam No. 4 is the control for the gage; lowest point in crest of dam is at 9.4 feet gage height, which is the point of zero flow except for leakage through dam, lock gates and valves. Backwater submerges dam No. 4 during extreme floods on Ohio River.

Extremes of stage.—Maximum stage recorded during year, 21.9 feet at 8 a. m. January 22; minimum stage, 9.48 feet at 6 p. m. September 20.

Highest headwater as reported by lockmaster occurred in 1897, and was equivalent to a gage height of about 30 feet on the lower gage, which corresponds to a reading of about 24.4 on upper gage, assuming 1 foot fall at dam. Highest backwater was during the flood of 1913, when crest was at 19.2 feet on upper gage.

Ice.—Stage-discharge relation probably not affected by ice.

Regulation.—Flow may be affected at times by the manipulation of the pool above dam No. 5, about 9.5 miles above dam No. 4, and the occasional use of flash boards on dam No. 4.

Accuracy—Stage-discharge relation practically permanent; not affected by ice during year. Variable leakage through lock and dam may affect the stage-discharge relation at low stages. Data inadequate for determining daily discharge. Gage read twice daily to hundredths. Previous to April 25, 1915, gage read once daily to tenths. Records excellent.

Cooperation.—Base data furnished by United States Engineer Corps.

Discharge measurements of Little Kanawha River at Lock 4, Palestine, W. Va., during the year ending Sept. 30, 1917.

[Made by U. S. Army Engineers.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Feb. 25	15.30	15,500	Mar. 13	18.83	28,600
26	12.72	6,900	13	18.77	28,800

Daily gage height, in feet, of Little Kanawha River at Lock 4, Palestine, W. Va., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	10.08	9.73	10.50	10.83	11.39	15.37	10.47	10.84	11.56	10.02	9.99	10.61
2	10.27	9.73	10.48	10.67	11.15	14.09	10.41	10.66	12.70	9.92	9.87	10.09
3	10.05	9.72	10.29	12.05	11.81	13.77	10.38	10.49	13.12	9.85	9.93	9.85
4	9.93	9.65	10.21	14.79	10.49	16.12	10.32	10.33	12.20	9.80	9.82	9.79
5	9.82	9.66	10.30	12.66	10.33	14.88	10.66	10.21	11.16	9.73	9.71	9.79
6	9.75	9.66	11.79	13.29	10.31	14.43	15.83	10.16	10.74	9.66	9.62	9.71
7	9.69	9.61	11.26	12.89	10.38	13.58	16.23	10.18	10.97	9.66	9.59	9.79
8	9.65	9.61	10.68	11.80	10.37	17.24	13.82	10.14	11.19	10.38	9.55	10.22
9	9.60	9.59	10.50	11.13	10.49	17.90	12.21	10.14	11.02	10.00	9.69	10.13
10	9.58	9.63	10.41	11.85	10.52	14.58	11.50	10.28	12.72	9.87	9.75	10.15
11	9.59	9.65	10.40	10.65	10.52	12.81	11.08	10.35	12.27	9.66	9.72	10.08
12	9.59	9.70	10.34	10.47	10.23	20.60	10.85	10.34	11.54	9.83	9.80	9.93
13	9.60	9.71	10.29	10.24	10.14	19.05	10.74	10.23	10.92	9.90	9.60	9.86
14	9.70	9.75	10.23	10.33	10.15	18.67	10.60	10.16	10.57	9.75	9.66	9.77
15	9.71	9.77	10.10	10.72	10.12	15.24	10.49	10.15	10.36	10.23	9.68	9.71
16	9.67	9.75	9.95	10.87	10.12	12.63	10.34	10.10	10.22	10.23	9.61	9.67
17	9.60	9.73	10.08	10.77	10.18	12.22	10.29	10.02	10.13	10.27	9.59	9.61
18	9.60	9.73	10.06	10.78	11.22	12.66	10.20	9.99	10.06	10.27	9.54	9.58
19	10.18	9.73	9.99	10.74	11.98	12.00	10.48	9.95	10.00	10.69	9.54	9.55
20	11.76	9.73	10.00	10.63	11.98	11.46	10.27	9.89	9.94	10.62	9.52	9.51
21	11.47	9.72	10.61	11.70	11.64	11.40	10.19	9.94	9.84	10.38	9.52	9.56
22	11.17	9.70	13.71	21.80	11.24	11.86	10.12	9.92	9.82	10.30	9.52	9.95
23	10.59	9.73	14.17	18.54	11.42	11.90	10.09	10.95	9.85	10.27	10.47	9.69
24	10.29	9.75	12.35	13.20	15.25	14.14	10.05	10.54	9.84	10.13	10.33	9.61
25	10.15	10.46	11.27	11.51	15.16	13.31	10.05	10.30	9.80	10.09	10.17	9.61
26	10.06	10.84	10.93	11.12	12.60	12.07	10.16	10.15	9.71	10.45	10.01	9.62
27	9.95	10.51	10.62	10.80	12.25	11.47	10.12	15.77	9.69	11.37	9.82	9.58
28	9.83	10.29	13.15	11.96	14.13	11.17	10.12	20.62	9.67	10.83	9.74	9.60
29	9.80	10.20	15.46	11.87	......	10.99	10.50	19.42	9.75	10.56	9.65	9.60
30	9.77	10.32	13.04	11.27	......	10.77	10.82	15.65	10.02	10.24	9.76	9.69
31	9.73	......	11.35	11.91	......	10.63	......	12.50	......	10.05	10.61	......

SOUTH FORK OF HUGHES RIVER AT MACFARLAN, W. VA.

Location.—About 80 feet above highway bridge half a mile east of Macfarlan, Ritchie County. Dutchman Run enters river on left 3,000 feet below station.

Drainage area.—210 square miles (measured on topographic maps).

Records available.—May 17, 1915, to September 30, 1917.

Gage.—Vertical staff on right bank; read by A. H. Reynolds.

Discharge measurements.—Made from bridge or by wading.

Channel and control.—One channel at all stages; straight 300 feet above and 1,500 feet below bridge. Bed of stream rock and mud. Control probably fairly permanent.

Extremes of stage.—Maximum stage recorded during the year, 25.7 feet at 8 a. m. January 22; minimum stage, 1.90 feet October 4–8.

Highest flood known reached a stage represented by gage height about 29 feet.

Ice.—Stage-discharge relation affected by ice during severe winters.

Accuracy.—Stage-discharge relation practically permanent; probably affected by ice part of February. Rating curve well defined between 100 and 2,660 second-feet and fairly well defined at other stages. Gage read twice daily to hundredths. Record of daily discharge withheld because gage was not checked during 1917.

Cooperation.—Base data furnished by United States Engineer Corps.

Daily gage height, in feet, of South Fork of Hughes River at Macfarlan, W. Va., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.96	2.10	2.70	3.30	3.90	7.35	2.80	3.42	4.80	2.72	2.62	6.20
2	1.90	2.12	2.82	3.31	3.49	5.59	2.80	2.90	7.35	2.59	2.55	4.13
3	1.92	2.12	2.66	7.95	3.00	5.10	2.80	2.75	6.08	2.43	2.65	3.67
4	1.90	2.15	2.62	5.85	3.00	7.30	2.78	2.70	4.40	2.35	2.57	3.52
5	1.90	2.20	2.83	4.56	2.96	6.28	3.85	2.70	3.86	2.33	2.45	3.36
6	1.90	2.05	3.30	5.50	2.96	5.08	15.45	2.69	3.54	2.29	2.39	3.38
7	1.90	2.00	3.05	4.10	2.96	7.20	9.85	2.61	3.43	2.26	2.34	5.78
8	1.90	2.00	2.86	3.69	2.96	14.05	5.15	2.55	3.51	2.27	2.31	3.68
9	2.00	2.00	2.83	3.45	2.90	7.10	4.23	2.58	3.33	2.26	2.36	3.90
10	2.55	2.07	2.80	3.23	2.90	5.30	3.79	2.63	5.96	2.29	2.58	3.40
11	2.60	2.16	2.80	2.89	2.90	5.65	3.48	2.58	5.03	2.30	2.45	3.36
12	3.10	2.38	2.80	2.67	2.90	15.95	3.32	2.50	3.78	2.30	2.38	3.20
13	2.10	2.35	2.78	2.74	2.90	9.15	3.14	2.48	3.40	2.28	2.30	3.20
14	2.00	2.30	2.68	2.90	2.90	7.65	2.83	2.31	3.05	2.34	2.30	3.00
15	2.20	2.30	2.43	3.40	2.90	5.69	2.28	2.30	2.95	6.60	2.30	2.90
16	2.34	2.30	2.46	2.34	2.00	4.39	2.83	2.26	2.86	6.40	2.33	2.84
17	2.40	2.40	2.40	3.20	2.95	4.25	2.68	2.25	3.68	4.15	2.40	2.73
18	2.80	2.40	2.35	3.21	3.93	4.29	2.62	2.23	2.69	3.57	2.20	2.65
19	5.00	2.40	2.34	3.18	3.99	4.25	2.61	2.20	2.59	3.65	2.38	2.60
20	5.20	2.40	2.34	2.70	4.15	3.80	2.66	2.23	2.54	3.39	2.27	2.62
21	3.95	2.35	2.82	6.33	3.70	3.73	2.60	2.92	2.50	3.00	2.20	2.68
22	3.30	2.20	6.05	22.85	3.35	3.90	2.54	3.05	2.48	2.95	2.22	2.60
23	2.03	2.12	4.35	7.55	4.20	3.70	2.54	6.22	2.37	3.40	2.68	2.58
24	2.62	2.45	3.65	4.08	8.90	8.38	2.49	3.95	2.20	3.10	4.23	2.54
25	2.40	2.74	3.46	3.69	4.37	4.80	2.44	3.10	2.35	3.12	3.33	2.52
26	2.35	3.35	3.10	3.39	3.97	3.23	2.51	3.16	2.34	3.90	2.82	2.45
27	2.29	3.35	3.22	3.31	5.80	3.69	2.57	18.88	2.33	3.06	2.53	2.45
28	2.23	2.60	10.35	5.33	7.28	3.52	2.87	14.25	2.38	4.22	2.47	2.60
29	2.20	2.80	6.50	5.20	....	3.30	3.48	8.30	3.10	3.48	2.47	2.60
30	2.13	3.10	3.89	5.32	....	3.10	3.72	5.10	2.87	3.04	2.82	2.60
31	2.10	....	3.30	4.15	....	2.95	....	4.16	....	2.78	7.33	....

HUGHES RIVER AT CISKO, W. VA.

Location.—At Cisko, about 1 mile below junction of North and South forks and 6 miles south of Petroleum, Ritchie County.

Drainage area.—453 square miles (measured on topographic maps).

Records available.—May 29, 1915, to September 30, 1917.

Gage.—Vertical and inclined staff on right bank; read by S. J. Enoch.

Discharge measurements.—Made from cable 40 feet below gage or by wading at the same section.

Channel and control.—One channel at all stages; straight for about 150 feet above and 500 feet below cable section. Bed of river is sand, gravel, mud, and boulders; control is probably permanent.

Extremes of stage.—Maximum stage recorded during year, 30.25 feet at 3 p. m. January 22; minimum, 2.14 feet October 14 and 15.

Highest known flood previous to January, 1917, reached a stage represented by gage height about 30 feet.

Ice.—Stage-discharge relation affected by ice during winter months.

Accuracy.—Stage-discharge relation probably permanent; probably affected by ice December, January, and February. Stages of Ohio River at Parkersburg of about 40 feet or more will probably cause backwater at the gage. Records of daily discharge withheld because gage has not been checked since installation. Gage read twice daily to hundredths. Records excellent except for possible errors in gage.

Cooperation.—Base data furnished by United States Engineer Corps.

Discharge measurements of Hughes River at Cisko, W. Va., during the year ending Sept. 30, 1917.

[Made by U. S. Army Engineers.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Mar. 9	11.30	4,880	Mar. 9	9.87	3,840	Mar. 14	12.17	5,720
9	10.60	4,420	13	8.3	2,620	14	11.65	5,000

Daily gage height, in feet, of Hughes River at Cisko, W. Va., for the year ending Sept 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.33	2.63	3.99	4.50	5.14	8.77	3.71	4.45	5.69	3.18	3.19	8.37
2	2.45	2.69	3.70	4.15	4.62	7.00	3.70	4.06	9.43	3.00	3.40	4.72
3	2.38	2 65	3.49	8.78	3.98	6.40	3.77	3.79	7.73	2.81	3.33	4.15
4	2.37	2.73	3.33	9.01	3.90	8.69	3.69	3.59	5.58	2.67	2.94	3.89
5	2.30	2.57	3.37	7.83	3.86	7.62	5.06	3.69	4.68	2.56	2.76	3.87
6	2.25	2.59	3.97	7.76	3.76	6.42	19.80	3.70	4.26	2.49	2.75	3.56
7	2.26	2.57	3.88	5.56	3.57	7.49	13.12	3.57	4.35	2.45	2.66	5.15
8	2.28	2.53	3.59	4.76	3.50	16.50	6.87	3.48	4.29	2.50	2.49	4.83
9	2.17	2.49	3.49	4.35	3.73	11.51	5.60	3.47	4.50	2.46	2.40	4.15
10	2.25	2.61	3.53	4.14	3.94	7.50	4.95	3.45	9.48	2.69	2.61	3.74
11	2.17	2.86	3.51	3.94	3.66	8.65	4.53	3.37	7.36	2.81	2.70	3.46
12	2.17	2.89	3.50	3.64	3.46	16.00	4.30	3.27	4.96	2.83	2.55	3.18
13	2.24	3.07	3.49	3.37	3.24	8.53	4.15	3.19	4.30	2.68	2.50	3.01
14	2.15	2.95	3.30	3.49	3.15	11.05	3.94	3.11	3.92	2.63	2.49	2.93
15	2.15	2.99	3.17	4.40	3.20	7.10	3.77	3.06	3.67	6.76	2.62	2.82
16	2.29	3.07	3.16	4.72	3.31	5.48	3.64	2.99	3.48	8.03	2.56	2.69
17	2.62	3.13	3.07	4.42	3.34	6.14	3.53	2.93	3.34	4.92	2.55	2.72
18	3.37	3.07	2.98	4.16	4.46	6.75	3.45	2.86	3.21	4.27	2.48	2.56
19	5.95	2.97	3.01	4.03	5.04	5.41	3.48	2.80	3.13	4.34	2.41	2.48
20	7.02	2.90	2.95	3.88	5.15	4.88	3.48	3.25	3.08	4.04	2.41	2.48
21	5.13	2.82	3.35	7.69	4.92	4.82	3.38	4.88	2.94	3.77	2.36	2.42
22	4.39	2.78	8.65	28.32	4.37	4.97	3.30	3.89	2.87	3.59	2.25	2.60
23	3.81	2.79	6.25	9.27	5.67	5.14	3.21	6.43	2.85	3.76	2.75	2.61
24	3.48	3.11	4.73	5.45	10.20	13.57	3.16	4.73	2.69	3.73	5.02	2.59
25	3.24	4.28	4.43	4.82	615	7.06	3.15	3.95	2.72	3.37	4.24	2.43
26	3.12	3.95	4.12	4.49	5.08	5.36	3.62	3.61	2.55	3.57	3.61	2.35
27	2.94	3.59	5.39	4.12	5.82	4.80	3.57	19.65	2.60	5.01	3.23	2.35
28	2.93	3.35	12.40	6.78	7.75	4.61	4.29	20.38	2.63	6.03	2.96	2.33
29	2.77	3.35	9.03	7.00	......	4.32	5.07	12.86	3.30	4.30	2.87	2.37
30	2.76	3.75	5.39	7.55	......	4.06	4.77	6.44	3.34	3.78	3.02	2.38
31	2.80	......	4.55	5.61	......	3.85	......	5.13	......	3.44	6.62	......

HOCKING RIVER BASIN.

HOCKING RIVER AT ATHENS, OHIO.

Location.—At single-span highway bridge at Mill Street, about three-fourths of a mile from business section of Athens, Athens County. Margaret Creek enters on right, 3½ miles above station.

Drainage area.—944 square miles (measured on topographic maps).

Records available.—May 3, 1915, to September 30, 1917.

Gage.—Vertical and inclined staff at downstream end of right abutment; read by Paul B. Casley.

Discharge measurements.—Made from bridge or by wading.

Channel and control.—Channel straight about 700 feet above and below station. Left bank overflows at gage height 17 feet and water passes around bridge. Bed of stream rocky with sand deposits near both banks. Ruins of old mill dam 300 feet below gage act as control. Stage-discharge relations will shift as dam decays.

Extremes of discharge.—Maximum stage recorded during year, 16.4 feet at 8 a. m. January 23 (discharge, 10,900 second-feet); minimum stage, 2.80 feet several days in October (discharge, 65 second-feet).

Highest flood known reached a stage represented by gage height about 26 feet.

Ice.—Stage-discharge relation probably not materially affected by ice except during extremely cold weather.

Accuracy.—Stage-discharge relation practically permanent; affected by ice December 18–19, January 14–20, and February 15–17. Rating curve well defined to 12,000 second-feet; above this point curve is an extension. Gage read twice daily to hundredths. Daily discharge obtained by applying mean daily gage height to rating table except for periods affected by ice. Records excellent.

Cooperation.—Base data furnished by United States Engineer Corps.

Daily discharge, in second-feet, of Hocking River at Athens, Ohio, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	79	85	131	598	2,320	910	598	850	5,160	2,780	260	140
2	71	79	125	495	1,480	850	910	625	8,540	1,750	280	194
3	71	88	125	970	970	790	1,610	520	6,750	970	260	170
4	71	79	113	1,220	708	1,280	970	470	2,030	570	205	110
5	83	85	161	4,660	625	1,160	850	680	1,220	445	194	102
6	71	88	348	8,140	520	625	7,470	598	1,090	370	260	131
7	83	83	219	5,160	545	970	10,100	545	970	495	240	240
8	77	81	174	3,000	570	3,860	4,500	495	762	4,990	222	155
9	83	92	161	1,480	545	3,300	2,480	570	850	1,220	280	131
10	71	92	125	1,030	570	2,180	1,540	445	1,420	735	240	125
11	75	92	143	850	545	4,180	1,160	520	1,750	625	202	125
12	83	98	137	598	470	6,930	970	470	1,090	545	302	170
13	79	92	119	495	420	5,850	910	348	680	545	348	128
14	83	98	85		280	8,040	708	445	545	652	240	131
15	88	100	79			6,930	652	420	545	2,400	260	75
16	85	95	75		280	4,340	570	370	470	2,180	194	79
17	79	88	67	400		2,480	520	420	395	1,750	205	85
18	88	92	60		280	1,540	970	348	470	1,890	177	79
19	208	95	60		370	1,030	910	260	348	2,620	170	116
20	370	85	110		545	970	680	325	302	1,030	140	90
21	280	88	280	470	625	1,090	520	545	325	625	131	98
22	216	92	470	10,100	495	1,350	520	520	240	520	98	146
23	149	119	445	10,700	652	1,220	420	520	395	545	302	194
24	131	155	495	8,940	5,160	6,660	470	420	545	470	280	170
25	108	167	276	2,550	2,620	4,180	652	280	395	445	131	170
26	92	146	302	1,540	1,420	2,320	598	325	268	445	140	155
27	85	134	5,080	970	1,220	1,350	570	4,180	268	625	131	161
28	79	122	8,240	1,960	970	1,160	790	6,750	280	850	194	161
29	83	113	3,380	3,860	......	910	910	9,050	2,100	520	205	116
30	81	137	1,350	6,030	......	762	790	8,080	3,220	348	161	85
31	88	......	680	3,220	......	680	......	1,480	......	240	212	......

Note.—Daily discharge estimated, because of ice from climatic data: Dec. 18–19, Jan. 14–20, Feb. 15–17. Braced figures show mean for the periods.

Monthly discharge of Hocking River at Athens, Ohio, for the year ending Sept. 30, 1917.

[Drainage area, 944 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	370	71	109	0.115	0.13
November	167	79	102	.108	.12
December	8,240	....	762	.807	.93
January	10,700	....	2,480	2.63	3.03
February	5,160	....	920	.975	1.02
March	8,040	625	2,580	2.73	3.15
April	10,100	420	1,510	1.60	1.78
May	9,050	260	1,190	1.26	1.45
June	8,540	240	1,450	1.54	1.72
July	4,990	240	1,100	1.17	1.35
August	348	98	215	.228	.26
September	240	75	134	.142	.16
The year	10,700	....	1,050	1.11	15.10

KANAWHA RIVER BASIN.

NEW RIVER AT EGGLESTON, VA.

LOCATION.—At highway bridge at Eggleston, Giles County.

DRAINAGE AREA.—2,920 square miles.

RECORDS AVAILABLE.—October 1, 1914, to September 30, 1917.

GAGE.—Chain gage attached to downstream side of bridge, read by J. A. Bishop.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge.

CHANNEL AND CONTROL.—Stream bed composed of rock covered with silt. Primary control is rock ledge about 1¼ miles below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.86 feet at 8 a. m.; March 5 (discharge, 28,400 second-feet); minimum stage, 2.37 feet at 5 p. m., August 29 (discharge, 652 second-feet). The flood of 1878 reached a stage of about 40 feet on present gage.

ICE.—Stage-discharge relation affected by ice during severe winters.

ACCURACY.—Stage-discharge relation practically permanent; see foot-notes to tables of daily discharge for effect of ice. Rating curve well defined between 1,200 and 45,000 second-feet; extended beyond these limits. Gage read twice daily to hundredths. Daily discharge ascertained by applying mean daily gage height to rating table, except as noted. Records excellent.

Discharge measurements of New River at Eggleston, Va., during the year ending Sept. 30. 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Dec. 9	Lee and Walters	3.84	2,310
June 26	B. E. Jones	3.19	1,370

Daily discharge, in second-feet, of New River at Eggleston, Va., for the years ending Sept. 30, 1915–1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1914–15.												
1	911	1,670	7,120	7,750	5,690	5,220	3,510	3,120	3,310	2,120	1,970	4,990
2	971	1,280	12,700	6,430	25,400	4,990	3,510	2,940	5,690	1,970	1,460	4,330
3	911	1,400	14,000	5,450	17,400	4,990	3,510	2,770	6,690	1,530	1,530	3,510
4	1,030	1,400	9,750	4,770	12,000	4,990	3,310	2,940	5,450	1,530	1,530	3,910
5	1,360	1,670	33,000	4,550	9,160	4,990	3,310	2,940	4,550	2,120	2,120	10,700
6	2,390	1,600	22,100	4,550	8,580	4,990	3,510	2,940	3,710	2,940	2,280	25,400
7	1,990	1,400	13,000	30,100	8,300	5,450	3,510	2,940	3,310	2,940	1,970	13,000
8	2,120	1,400	10,000	20,500	7,480	5,690	3,310	2,770	3,120	2,940	1,670	5,930
9	2,250	1,220	7,120	11,000	6,690	4,990	3,310	3,120	2,940	2,600	1,400	5,450
10	1,610	1,280	6,180	4,770	5,930	4,770	3,310	3,120	3,120	2,120	1,530	4,550
11	911	1,460	5,450	6,690	5,690	4,990	3,310	2,940	2,770	1,970	1,970	3,910
12	1,030	1,670	5,220	8,020	5,450	4,990	3,710	2,770	2,600	1,530	2,280	3,910
13	1,320	1,460	4,990	12,000	5,220	5,220	4,120	2,940	2,600	1,820	3,710	4,330
14	1,070	1,400	4,330	9,160	4,990	4,550	3,910	3,310	2,120	1,970	3,310	4,990
15	1,190	1,740	3,810	7,750	4,990	4,330	3,710	3,310	3,120	1,670	3,120	4,330
16	7,720	4,770	2,690	7,750	5,690	4,330	3,510	2,770	3,310	1,670	2,120	3,910
17	11,700	4,990	2,990	8,300	6,180	5,220	3,310	2,600	4,120	1,970	4,120	3,510
18	5,170	3,710	3,150	8,580	5,690	4,990	3,120	3,310	3,510	1,970	4,330	3,510
19	3,310	2,940	3,480	11,300	5,220	4,990	2,940	2,940	3,120	1,530	2,770	3,120
20	2,830	2,770	4,830	11,300	4,770	4,330	3,120	2,280	2,600	1,820	2,440	2,940
21	2,600	2,120	6,620	9,160	5,220	4,330	2,940	2,440	2,280	1,970	2,440	3,120
22	2,120	1,740	8,890	7,120	4,550	4,120	2,940	2,600	2,440	2,280	6,430	2,940
23	1,970	1,820	7,350	6,430	4,550	4,120	2,940	3,310	2,600	2,440	3,710	2,600
24	1,820	1,970	5,900	6,430	5,450	3,910	2,940	3,510	1,970	2,940	2,940	2,440
25	1,970	1,970	5,900	6,690	9,750	3,910	2,940	4,120	1,970	2,120	2,600	2,280
26	1,970	1,970	10,500	7,480	8,020	3,710	2,940	3,710	1,970	1,820	2,280	2,120
27	2,280	1,820	9,290	7,480	6,430	3,710	3,120	2,940	1,820	2,120	2,120	1,670
28	1,970	2,120	6,620	6,430	5,690	3,710	2,770	2,940	1,400	1,820	2,940	2,440
29	1,820	1,820	6,620	5,930	....	3,510	2,940	2,770	1,400	1,530	3,310	2,280
30	1,670	1,670	8,890	5,450	....	4,550	3,120	3,310	1,970	1,400	5,220	2,280
31	1,670	....	9,160	5,220	....	3,710	....	3,310	....	1,400	5,220	....
1915–16.												
1	5,450	2,360	3,120	9,750	6,430	5,220	4,330	2,770	2,200	2,520	5,450	4,550
2	20,500	2,940	2,770	7,480	11,000	4,990	3,910	3,510	2,600	2,600	7,120	3,710
3	8,300	2,360	3,120	7,480	20,100	5,450	3,910	2,600	2,520	1,970	9,750	3,710
4	5,930	2,040	3,120	6,180	13,000	6,950	3,910	2,600	2,280	2,940	6,690	3,510
5	4,990	2,280	2,200	5,690	9,750	6,430	4,120	2,600	1,740	2,200	8,580	4,120
6	5,690	2,770	2,200	5,220	7,480	5,690	4,120	3,310	2,770	2,360	7,120	3,710
7	6,430	2,360	3,120	5,450	6,950	5,690	4,550	3,710	2,200	2,040	8,870	3,310
8	5,690	2,360	2,360	18,100	5,930	5,930	5,220	1,900	3,120	1,740	9,750	3,310
9	4,990	2,520	2,440	13,000	5,450	6,430	5,930	2,940	2,600	1,740	10,700	4,550
10	4,990	2,280	2,200	7,480	5,450	5,930	4,770	2,440	2,440	2,440	6,180	2,940
11	3,910	2,770	2,120	7,480	5,220	5,220	4,550	2,440	2,440	19,700	7,120	2,940
12	3,710	2,600	2,940	6,690	4,990	5,450	4,990	2,440	1,900	11,600	6,430	3,710
13	3,510	2,280	2,770	7,120	4,770	5,690	4,120	2,200	2,520	5,930	6,180	2,940
14	3,510	2,120	2,860	5,690	4,770	5,220	5,690	2,600	2,200	4,770	4,990	2,770
15	3,510	1,900	2,800	5,450	4,330	4,990	5,220	2,280	2,360	5,220	5,220	3,310
16	3,710	2,940	2,800	4,990	4,330	4,550	4,550	3,120	2,940	108,000	13,000	8,300
17	3,510	2,600	3,100	4,770	4,120	3,910	4,120	2,360	4,990	72,500	11,000	4,120
18	3,120	2,520	3,400	4,330	4,330	3,910	4,120	2,280	5,930	34,700	9,160	3,310
19	3,120	2,770	25,000	4,300	4,330	3,910	3,710	2,200	3,910	20,900	6,180	3,310
20	3,310	7,120	13,000	4,200	4,330	3,710	3,510	2,040	3,710	14,000	5,450	3,120
21	2,940	5,450	6,430	3,910	3,910	4,120	3,510	1,820	3,120	13,000	4,990	2,770
22	3,910	4,770	5,930	4,770	4,120	4,120	3,510	1,670	3,120	12,700	4,990	2,940
23	3,510	3,310	4,990	5,690	3,910	3,910	3,510	1,970	2,360	12,700	6,950	2,940
24	3,310	3,510	4,550	5,690	4,550	3,910	3,120	3,310	2,280	11,000	7,750	2,770
25	3,120	3,120	4,120	5,690	13,700	3,710	3,310	4,770	2,770	9,160	5,220	2,440
26	3,120	2,770	5,690	4,550	10,000	3,510	3,310	4,120	1,900	8,300	4,550	2,940
27	2,940	3,120	5,930	6,950	7,750	3,710	3,310	3,120	3,120	8,020	4,120	2,940
28	2,940	3,310	5,450	5,690	6,180	4,990	3,510	4,120	2,940	7,480	4,550	2,600
29	3,120	3,310	6,950	6,430	5,450	5,930	3,310	2,440	2,440	7,120	6,430	3,510
30	2,520	3,310	22,500	6,180	....	4,990	2,940	3,310	2,520	7,480	5,220	7,120
31	3,710	....	14,400	5,930	....	4,550	....	2,600	....	6,180	4,120	....

Daily discharge, in second-feet, of New River at Eggleston, Va., for the years ending Sept. 30, 1915–1917—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1916–17.												
1	4,330	3,120	2,440	3,710	4,990	4,770	4,330	3,910	1,970	1,530	1,530	1,400
2	3,310	3,120	2,600	3,310		7,480	4,120	4,120	1,900	1,530	1,530	1,970
3	3,310	2,940	2,600	3,710		12,000	3,510	3,910	2,600	1,120	1,460	1,970
4	2,770	2,770	2,600	4,550		15,500	3,120	3,710	2,280	1,400	1,530	2,600
5	2,770	2,600	2,280	10,400		27,100	3,910	3,310	2,600	1,460	2,280	2,200
6	2,600	1,900	2,360	11,000		17,400	6,690	3,120	2,040	1,530	1,900	1,900
7	2,940	2,200	2,360	8,580		11,000	7,210	3,120	1,740	1,530	1,820	1,820
8	2,770	2,200	2,120	6,950		8,870	5,690	3,910	1,820	1,600	1,530	1,900
9	2,280	2,520	2,280	5,690	3,500	7,480	5,220	3,710	1,820	1,340	1,460	1,670
10	3,120	2,600		4,770		6,690	5,220	3,910	1,970	1,400	1,530	1,600
11	3,120	2,360		3,310		6,180	4,990	3,910	2,040	1,820	1,740	1,340
12	2,440	2,200		4,120		5,450	4,770	3,910	2,280	1,530	1,970	1,280
13	2,200	1,740		3,310		6,180	4,770	3,710	1,740	1,740	2,040	1,340
14	2,360	2,520		2,940		6,950	4,770	2,600	1,670	1,820	1,900	1,460
15	2,600	2,520		3,120		6,950	4,330	3,510	1,740	1,530	1,530	1,340
16	1,900	2,120		4,770		6,430	3,910	3,120	1,670	1,400	1,340	1,400
17	2,600	2,360		3,710	7,480	6,950	4,120	2,600	1,740	2,040	1,530	1,400
18	3,510	2,440		4,120	7,750	10,000	4,120	2,520	1,900	3,310	1,340	1,400
19	3,910	2,360		4,120	6,690	8,870	3,710	2,360	1,600	3,310	1,670	1,400
20	13,000	1,970	2,600	4,330	4,990	7,210	3,510	2,120	1,460	3,120	1,600	1,340
21	5,930	2,520		4,120	6,180	6,430	3,310	1,900	1,530	2,040	1,280	1,340
22	4,770	2,440		3,910	5,930	5,930	3,120	1,900	1,600	2,360	1,340	1,280
23	3,910	2,440		4,990	4,990	5,930	3,120	2,360	1,600	3,310	1,530	1,220
24	2,520	2,600		6,180	6,430	6,950	3,710	2,360	1,670	4,990	1,600	1,170
25	2,770	3,120		5,220	7,210	8,300	3,310	2,040	1,900	6,430	1,400	1,280
26	3,120	2,770		4,770	5,930	8,580	3,120	1,970	1,400	6,180	1,400	1,340
27	2,940	1,900		4,330	4,990	6,950	3,120	2,040	1,530	4,770	1,020	1,280
28	2,940	2,360		3,910	4,550	5,930	2,200	2,120	1,820	3,510	684	1,280
29	2,440	2,440		3,710	....	5,450	3,120	2,600	1,460	2,600	670	1,340
30	2,280	2,200		4,550	....	4,990	3,510	2,940	1,460	2,120	1,460	1,460
31	3,120	....		7,210	....	4,550	....	2,280	....	1,970	1,170	....

NOTE.—Daily discharge estimated, because of ice, from observer's notes, climatic data, and by comparison with discharge at Radford as follows: 1914–15, Dec. 15–30; 1915–16, Dec. 14–18, and Jan. 19–20; 1916–17, Dec. 10–31, Feb. 2–16. Daily discharge Oct. 1–20, 1915, estimated from flow at Radford. Determinations of daily and monthly discharge for 1914–15 differ slightly from those published in Water Supply Paper No. 423, owing to revision of rating curve. Braced figures show mean discharge for period included.

Monthly discharge of New River at Eggleston, Va., for the years ending Sept. 30, 1915–1917.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1914–15.					
October	11,700	911	2,380	0.815	0.94
November	4,990	1,220	2,010	.688	.77
December	33,000	2,690	8,440	2.89	3.33
January	30,100	4,550	8,530	2.92	3.37
February	25,400	4,550	7,510	2.57	2.68
March	5,690	3,510	4,590	1.57	1.81
April	4,120	2,770	3,280	1.12	1.25
May	4,120	2,280	3,020	1.03	1.19
June	6,690	1,400	3,050	1.04	1.16
July	2,940	1,400	2,020	.692	.80
August	6,430	1,400	2,800	.959	1.10
September	25,400	1,670	4,810	1.65	1.84
The year	33,000	911	4,360	1.49	20.24

Monthly discharge of New River at Eggleston, Va., for the years ending Sept. 30, 1915–1917—Continued.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1915-16.					
October	20,500	2,520	4,610	1.58	1.82
November	7,120	1,900	3,000	1.03	1.15
December	25,000	2,120	5,630	1.93	2.22
January	18,100	3,910	6,530	2.24	2.58
February	20,100	3,910	6,780	2.32	2.50
March	6,950	3,510	4,930	1.69	1.95
April	5,930	2,940	4,090	1.40	1.56
May	4,770	1,670	2,760	.945	1.09
June	5,930	1,740	2,800	.959	1.07
July	108,000	1,740	13,600	4.66	5.37
August	13,000	4,120	6,900	2.36	2.72
September	8,300	2,440	3,610	1.24	1.38
The year	108,000	1,670	5,450	1.87	25.41
1916-17					
October	13,000	1,900	3,370	1.16	1.34
November	3,120	1,740	2,440	.836	.93
December			2,540	.870	1.00
January	11,000	2,940	4,950	1.70	1.96
February			4,660	1.60	1.67
March	27,100	4,550	8,370	2.87	3.31
April	7,210	2,200	4,120	1.41	1.57
May	4,120	1,900	2,950	1.01	1.16
June	2,600	1,400	1,820	.623	.70
July	6,430	1,120	2,460	.843	.97
August	2,280	670	1,510	.517	.60
September	2,600	1,170	1,520	.521	.58
The year	27,100	670	3,400	1.16	15.81

KANAWHA RIVER AT LOCK 2, MONTGOMERY, W. VA.

Location.—At Lock 2, three-fourths of a mile below Chesapeake & Ohio Railway station at Montgomery, Fayette County. Morris Creek enters on left about 300 feet below the gage.

Drainage area.—8,470 square miles.

Records available.—June 22, 1915, to September 30, 1917. Upper and lower gages at the lock have been read since December, 1887, under the direction of the Corps of Engineers, United States Army.

Gage.—Upper gage at lock, vertical and inclined staff on right bank, short distance above upper lock gates; vertical section fastened to land wall of lock, inclined section at upstream end of paved slope; read by George Meyers, lockmaster. A chain gage fastened to downstream handrail near center of toll bridge at Montgomery is used in referring water surface at bridge when making discharge measurements.

Discharge measurements.—Made from bridge at Montgomery or by wading on the crest of the dam.

Channel and control.—One channel at all stages; straight for 300 feet above and 800 feet below bridge. Bed of river composed of rock, sand, and mud. The dam at Lock No. 2 is control for all stages, as there is a fall of about 2 feet at the dam at the maximum stage. Except for the leakage through the dam and lock, point of zero flow is at lowest point in crest of dam, which is 17.9 feet above zero of upper gage.

Extremes of discharge.—Maximum stage recorded during year, 36.8 feet at 7 a. m. March 5 (discharge, 138,000 second-feet); minimum stage, 18.40 feet at 7 a. m. September 1 (discharge, 1,270 second-feet).

Highest stage recorded occurred May 23, 1901, at 6 a. m.; upper gage 49.65 lower gage 47.70 (discharge, about 250,000 second-feet).

Ice.—Stage-discharge relation not affected by ice.

Leakage.—At about gage height 19 feet on upper gage, leakage through the dam amounts to about 500 second-feet. Leakage through the lock gates amounts to about 110 and 260 second-feet, depending upon which of the two gates is closed.

Accuracy.—Stage-discharge relation practically permanent except as may be affected by change in leakage through lock and dam; not affected by ice. Rating curve well defined throughout. Gage read twice daily to hundredths since June 22, 1915; once daily previous to this date. Daily discharge ascertained by applying mean daily gage height to rating table which is adjusted for leakage through dam and lock gates. Records good.

Cooperation.—Base data furnished by United States Engineer Corps.

Discharge measurements of leakage through gates at Lock 2, Kanawha River, Montgomery, W. Va., during the year ending Sept. 30, 1917.

[Made by Peterson and Hopkins.]

Date.		Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Sept. 18	Upper gates	18.91	263
18	Lower gates	19.04	106

Discharge measurements of Kanawha River at Lock 2, Montgomery, W. Va., during the year ending Sept. 30, 1917.

[Made by Peterson and Hopkins.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Sept. 17	18.96	1,980
18	18.93	[a] 1,490

[a] Measured on crest of dam No. 2; does not include leakage through dam but does include leakage of 263 second-feet through lock.

Daily discharge, in second feet, of Kanawha River at Lock 2, Montgomery, W. Va., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	16,300	4,150	4,350	16,800	20,500	43,300	13,300	11,300	14,300	2,860	2,990	1,390
2	11,300	4,580	4,800	13,800	34,800	58,000	12,300	13,300	13,800	2,860	2,860	1,770
3	7,800	4,580	4,800	12,300	23,600	74,900	11,300	13,300	18,800	2,740	2,530	1,770
4	5,800	3,950	5,300	14,800	17,800	111,000	10,800	11,300	14,800	2,740	2,530	1,900
5	4,800	3,950	4,800	33,900	12,800	134,000	9,800	10,300	12,300	2,350	2,990	2,350
6	4,350	3,770	4,150	58,000	9,300	81,200	12,800	11,800	9,800	2,530	2,530	2,640
7	3,950	3,430	4,580	49,300	7,800	48,400	24,300	8,800	8,800	2,530	2,860	2,440
8	3,770	3,130	4,150	32,300	9,300	41,500	27,800	8,300	7,300	2,350	2,640	2,640
9	3,590	3,130	4,150	22,400	10,800	40,700	23,600	12,300	6,300	2,350	2,120	3,270
10	3,590	3,430	4,150	17,800	9,300	35,600	19,900	15,300	6,800	2,350	2,350	3,950
11	3,430	3,590	4,150	14,800	7,800	25,000	16,800	15,300	7,800	2,190	2,530	3,770
12	3,950	3,430	4,580	12,300	8,300	39,000	15,300	13,800	6,800	1,900	2,440	2,860
13	3,430	3,430	4,150	9,800	7,800	62,500	14,300	12,800	5,300	2,530	2,350	2,350
14	3,130	3,430	4,150	8,800	5,800	63,400	13,300	11,800	5,800	2,270	2,270	2,040
15	3,130	3,270	4,350	10,300	7,300	56,300	12,800	10,300	4,800	2,190	2,190	1,970
16	3,130	3,590	3,950	11,800	9,800	39,000	11,800	9,300	4,150	2,740	2,040	1,970
17	3,130	3,590	3,430	12,300	10,300	33,100	10,800	8,300	3,590	2,640	2,040	1,970
18	3,430	3,770	3,590	11,300	10,800	49,300	9,800	7,300	3,270	2,990	1,770	1,970
19	6,800	3,430	3,430	10,300	13,300	40,700	8,800	6,800	3,430	3,950	1,900	1,770
20	9,800	3,590	2,990	10,300	21,100	29,300	8,300	6,300	3,130	5,300	1,900	1,640
21	19,400	3,430	3,130	9,800	45,800	22,400	7,800	5,800	3,590	5,300	1,840	1,510
22	14,300	2,990	10,300	29,300	34,800	30,100	6,900	4,800	4,150	4,580	1,840	1,640
23	10,300	2,860	18,800	44,100	23,600	28,600	7,300	4,150	3,590	5,800	1,840	1,640
24	8,300	3,590	17,800	32,300	45,000	46,700	6,300	4,350	2,990	8,300	1,970	1,640
25	6,800	4,580	14,300	23,600	61,600	66,900	6,300	4,800	2,990	9,800	1,770	1,640
26	5,800	5,800	12,300	17,800	40,700	44,100	6,800	4,580	2,860	10,800	1,840	1,510
27	4,800	5,800	10,800	14,800	26,400	30,100	6,800	12,300	2,640	11,800	1,840	1,510
28	4,800	5,800	19,900	12,800	27,100	23,600	6,800	39,000	2,440	9,800	1,770	1,450
29	4,580	4,150	56,300	11,800	....	19,900	7,300	41,500	2,740	6,800	1,700	2,040
30	4,150	4,580	37,300	11,800	....	17,300	8,800	28,600	2,740	5,300	1,580	1,900
31	4,150	....	23,000	15,800	....	14,800	....	18,800	....	4,350	1,510	....

Monthly discharge of Kanawha River at Lock 2, Montgomery, W. Va., for the year ending Sept. 30, 1917.

[Drainage area, 8,470 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	19,400	3,130	6,320	0.743	0.86
November	5,800	2,860	3,890	.459	.51
December	56,300	2,690	9,930	1.17	1.35
January	58,000	8,800	19,600	2.31	2.66
February	61,600	5,800	20,100	2.37	2.47
March	134,000	14,800	46,800	5.53	6.38
April	27,800	6,300	12,000	1.42	1.58
May	41,500	4,150	12,500	1.48	1.71
June	18,800	2,440	6,390	.754	.84
July	11,800	1,900	4,420	.522	.60
August	2,990	1,510	2,170	.256	.30
September	3,950	1,390	2,100	.248	.28
The year	134,000	1,390	12,200	1.44	19.54

GREENBRIER RIVER AT ALDERSON, W. VA.

Location.—At reinforced concrete arch highway bridge at Alderson, Monroe County, half a mile above mouth of Muddy Creek.

Drainage area.—1,340 square miles.

Records available.—July 30, 1895, to July 15, 1906; May 10, 1907, to September 30, 1917.

Gage.—Chain gage attached to downstream side of bridge near center of second span from left side of river. Read by W. J. Hancock.

Discharge measurements.—Made from bridge or by wading.

Channel and control.—The channel and control are composed of coarse gravel and are practically permanent.

Extremes of discharge.—Maximum stage recorded during year, 14.2 feet at 6 p. m. March 4 (discharge, 34,000 second-feet); minimum stage, 1.60 feet August 31 (discharge, 74 second-feet). Maximum stage since establishment of station, 19.4 feet at 6 p. m. March 27, 1913 (discharge, about 62,000 second-feet).

Ice.—Stage-discharge relation occasionally affected by ice for short periods during severe winters.

Accuracy.—Stage-discharge relation practically permanent; affected by ice December 12–14 and February 12 and 13. Rating curve used during 1915, 1916, and 1917, fairly well defined between 100 and 28,000 second-feet; extended beyond these limits. Gage read twice daily to hundredths. Daily discharge ascertained by applying mean daily gage heights to rating table. Discharge December 12–14, 1917, interpolated because of ice conditions. Records good except for ice periods, for which they are poor.

Discharge measurements of Greenbrier River at Alderson, W. Va., during the year ending Sept. 30, 1917.

[Made by B. E. Jones.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
May 29	5.55	8,000
30	4.66	5,470
31	3.94	3,500

Daily discharge, in second-feet, of Greenbrier River at Alderson, W. Va., for the years ending Sept. 30, 1915–1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1914–15.												
1	64	218	169	4,490	4,490	2,500	804	1,250	204	185	137	463
2	66	185	547	3,710	27,800	2,090	777	1,080	516	169	133	394
3	66	169	1,250	2,810	24,800	1,700	725	1,000	626	185	126	345
4	69	158	1,420	1,510	15,200	1,420	686	1,160	7,500	204	536	394
5	72	164	1,990	1,060	6,120	1,420	649	1,160	5,300	268	916	725
6	90	153	5,300	1,510	5,850	1,340	637	1,000	2,810	336	637	1,000
7	92	142	3,030	26,300	7,500	1,420	592	832	1,990	336	536	818
8	92	126	2,190	16,700	6,680	1,510	686	777	1,420	355	394	637
9	97	133	1,790	11,600	5,580	1,340	930	699	1,160	374	311	526
10	92	115	1,700	9,800	3,960	1,340	1,080	649	902	302	302	432
11	100	118	1,700	7,500	3,250	1,600	1,000	581	712	239	253	336
12	118	111	1,890	6,400	2,600	1,790	1,160	526	592	211	246	277
13	111	115	1,890	6,400	2,190	1,790	1,080	526	526	197	260	260
14	122	115	1,890	5,580	1,600	1,510	1,250	484	615	190	364	253
15	239	122	1,890	3,480	3,480	1,420	1,080	484	1,600	185	790	294
16	403	122	1,890	4,220	7,780	1,420	930	463	1,700	197	604	232
17	1,080	218	1,890	5,300	5,300	1,600	874	442	1,510	153	818	190
18	860	311	1,790	11,600	3,480	1,510	777	413	2,090	137	637	174
19	637	253	1,990	14,900	2,600	1,420	725	345	1,990	122	526	158
20	581	286	4,490	13,400	1,990	1,160	673	355	1,340	197	818	164
21	432	253	8,600	9,500	1,700	1,160	660	355	874	260	604	345
22	374	185	8,900	6,680	1,510	1,080	712	336	660	204	463	660
23	311	185	8,050	5,850	1,340	930	764	403	484	185	526	930
24	239	158	7,220	5,300	3,250	860	558	463	452	355	570	738
25	239	118	6,400	5,850	12,800	818	526	442	384	268	442	526
26	268	137	5,580	6,120	6,950	790	604	474	294	204	345	384
27	286	153	4,760	5,850	4,220	832	581	484	246	174	302	374
28	345	142	5,300	5,030	3,030	874	592	463	211	211	277	336
29	320	164	5,850	3,710	....	860	712	452	190	190	294	294
30	294	190	6,120	3,030	....	888	1,250	452	179	169	423	268
31	225	....	6,120	2,810	....	902	....	239	....	158	547	....
1915–16.												
1	9,800	253	649	5,030	5,850	2,190	3,030	1,890	1,250	516	790	294
2	18,500	253	581	3,710	8,050	2,090	2,290	1,600	1,000	581	7,220	268
3	6,400	239	570	4,490	6,400	2,810	2,090	1,340	1,000	777	3,480	253
4	3,250	211	526	3,710	4,220	2,810	1,890	1,250	1,000	699	1,890	232
5	2,090	197	474	2,600	3,250	2,500	1,700	1,160	1,160	1,000	1,510	204
6	1,600	185	403	2,290	3,030	3,250	1,700	1,080	930	818	1,700	190
7	1,160	190	423	2,090	2,810	5,300	2,090	930	1,000	452	1,700	190
8	1,000	204	328	1,990	3,710	2,390	2,190	860	526	452	2,290	190
9	804	185	294	1,510	3,250	7,500	2,190	790	1,990	423	2,090	204
10	673	190	442	1,340	3,960	4,760	2,190	846	2,810	463	1,890	204
11	626	190	384	463	3,480	3,250	5,300	764	2,500	673	1,510	232
12	547	190	328	13,400	3,030	2,600	6,680	712	2,090	790	1,420	185
13	494	179	311	11,000	3,250	2,190	5,850	660	1,600	615	1,340	169
14	442	185	336	8,600	4,220	2,190	4,220	592	1,250	484	1,250	164
15	423	218	403	5,300	3,710	3,710	1,160	581	3,710	452	902	232
16	384	364	328	3,710	2,810	3,030	2,500	547	6,680	526	1,600	1,250
17	364	738	403	2,810	2,500	3,480	2,090	536	12,200	2,390	2,390	860
18	336	916	902	2,190	2,090	2,600	1,700	558	8,050	3,480	1,990	660
19	364	874	12,500	1,600	1,790	2,090	3,710	558	4,220	2,290	1,340	463
20	403	1,890	5,850	1,160	1,420	1,890	1,340	526	2,810	1,420	1,340	355
21	413	2,090	3,480	1,340	1,340	1,510	1,160	484	1,990	1,080	1,000	277
22	432	1,700	2,290	1,510	1,340	1,600	1,250	452	1,510	1,160	790	225
23	474	1,340	1,790	1,790	1,250	3,710	1,160	686	3,250	3,030	2,810	232
24	432	1,160	1,510	1,890	1,340	5,030	1,160	2,600	1,080	1,890	1,890	232
25	384	1,000	1,160	1,510	6,400	3,480	1,250	2,500	1,080	1,420	1,080	197
26	345	846	1,420	1,600	7,500	2,600	2,390	1,790	1,340	1,080	804	225
27	336	790	1,790	1,990	4,490	2,190	3,250	5,580	930	846	592	232
28	302	754	1,890	2,810	3,250	2,290	3,250	2,500	860	1,160	505	190
29	302	764	7,500	3,030	2,500	6,120	2,810	1,600	686	1,600	452	860
30	294	712	18,500	6,120	....	5,580	2,290	1,340	592	1,160	394	2,810
31	253	....	8,320	6,950	....	3,960	....	1,420	....	874	328	....

Daily discharge, in second-feet, of Greenbrier River at Alderson, W. Va., for the years ending Sept. 30, 1915–1917—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1916–17.												
1	2,190	328	558	2,500	6,120	12,800	1,700	3,710	2,600	179	345	82
2	1,250	311	615	1,990	6,400	11,300	1,510	4,490	2,090	218	302	87
3	860	286	649	1,790	4,220	12,500	1,420	3,250	2,090	211	846	82
4	637	277	592	2,390	2,390	27,200	1,340	2,290	2,390	239	374	79
5	536	260	547	5,580	1,790	24,800	1,340	1,990	2,390	225	277	84
6	463	260	547	10,400	1,510	9,800	5,580	1,790	2,090	218	302	90
7	394	246	536	8,600	1,420	6,120	6,950	1,420	1,700	197	277	93
8	345	232	494	5,030	1,420	5,580	5,030	1,420	1,420	174	246	169
9	320	225	526	3,480	1,420	11,600	5,030	1,990	1,160	158	286	218
10	294	218	494	2,600	1,080	7,500	3,480	3,030	930	137	311	338
11	277	232	494	2,090	916	4,760	2,810	2,810	930	137	336	649
12	260	225	479	1,600	888	9,800	2,390	2,390	902	133	345	423
13	260	239	463	1,060	902	20,600	2,390	2,090	764	137	268	311
14	239	253	448	1,890	738	17,600	2,390	1,790	649	122	218	225
15	260	260	432	3,030	777	14,300	2,090	1,510	581	118	185	185
16	225	239	526	2,810	846	8,900	1,790	1,250	526	153	174	158
17	260	204	277	2,190	790	10,100	1,510	1,080	474	246	148	133
18	345	225	442	1,790	930	11,600	1,340	1,000	452	260	133	122
19	505	218	442	1,600	1,420	7,500	1,160	874	413	302	133	118
20	1,420	185	442	1,420	3,710	5,030	1,080	790	384	516	122	104
21	1,420	179	442	1,340	7,500	3,960	1,000	725	442	432	115	100
22	1,080	190	725	6,400	5,300	6,120	930	673	505	374	115	95
23	860	204	2,190	13,700	4,220	6,400	902	686	463	463	107	97
24	712	225	2,190	6,680	12,200	14,600	804	673	364	604	100	92
25	604	328	1,890	4,220	12,800	13,700	777	649	311	874	97	90
26	558	902	1,420	3,030	6,950	7,220	760	615	277	3,030	97	90
27	463	673	1,340	2,390	4,490	4,760	874	1,250	253	1,700	100	95
28	432	526	2,810	1,890	4,220	3,480	818	12,500	232	1,080	97	130
29	394	494	15,200	1,790	....	2,810	902	8,050	218	738	90	164
30	355	526	8,050	2,290	....	2,500	2,600	5,580	204	526	84	225
31	355	....	3,480	3,250	....	1,990	....	3,480	....	423	74	....

Monthly discharge of Greenbrier River at Alderson, W. Va., for the years ending Sept. 30, 1915–1917.

[Drainage area, 1,340 square miles.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1914–15.					
October	1,080	64	270	0.201	0.23
November	311	111	167	.125	.14
December	8,900	169	3,660	2.73	3.15
January	26,300	1,080	7,030	5.25	6.06
February	27,800	1,340	6,320	4.72	4.92
March	2,500	790	1,330	.993	1.14
April	1,250	526	802	.599	.67
May	1,250	239	606	.452	.52
June	7,500	179	1,300	.970	1.08
July	374	122	223	.166	.19
August	916	126	456	.340	.39
September	1,000	158	431	.322	.36
The year	27,800	64	1,860	1.39	18.84

Monthly discharge of Greenbrier River at Alderson, W. Va., for the years ending Sept. 30, 1915–1917—Continued.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1915–16.					
October	18,500	253	1,730	1.29	1.49
November	2,090	179	634	.473	.53
December	18,500	294	2,450	1.83	2.11
January	13,400	463	3,530	2.63	3.03
February	8,050	1,250	3,530	2.63	2.84
March	7,500	1,510	3,250	2.43	2.80
April	6,680	1,160	2,530	1.89	2.11
May	5,580	452	1,250	.933	1.08
June	12,200	526	2,370	1.77	1.98
July	3,480	423	1,120	.836	.96
August	7,220	328	1,620	1.21	1.40
September	2,810	164	409	.305	.34
The year	18,500	164	2,030	1.51	20.67
1916–17.					
October	2,190	225	599	0.447	0.52
November	902	179	306	.228	.25
December	15,200	277	1,600	1.19	1.37
January	13,700	1,080	3,580	2.67	3.08
February	12,800	738	3,480	2.60	2.71
March	27,200	1,990	9,900	7.39	8.52
April	6,950	777	2,090	1.56	1.74
May	12,500	615	2,450	1.83	2.11
June	2,600	204	940	.701	.78
July	3,030	118	462	.345	.40
August	846	74	216	.161	.19
September	649	79	164	.122	.14
The year	27,200	74	2,150	1.60	21.81

LITTLE COAL RIVER AT McCORKLE, W. VA.

Location.—At McCorkle, Lincoln County, on Coal River branch of Chesapeake & Ohio Railway. Cobb Creek enters river on left about 400 feet below station.

Drainage area.—375 square miles (measured on topographic maps).

Records available.—July 23, 1915, to September 30, 1917.

Gage.—Vertical and inclined staff on left bank just below McCorkle Hotel; read by F. M. Priestly.

Discharge measurements.—Made from cable 40 feet above inclined section of gage or by wading.

Channel and control.—One channel at all stages; slightly curved above and below cable section. Bed of stream composed of loose sand; but control is probably fairly permanent. Flow of Cobb Creek affects stage at gage and should be included in station.

Extremes of discharge.—Maximum stage recorded during year, 13.0 feet at 5 p. m. March 3 (discharge about 8,000 second-feet); minimum stage, 1.50 feet October 6, 7, 8, and September 7 (discharge, .3 second-feet).

Highest known flood August 9, 1916, reached a stage of 28.57 feet (discharge, roughly, 24,000 second-feet).

Ice.—Stage-discharge relation not affected by ice to any extent during record.

Accuracy.—Stage-discharge relation practically permanent, changed by record flood of August, 1916. Rating curve used to August 10, 1916, well defined between 43 and 4,000 second-feet; curve used after this date well defined between 43 and 5,500 second-feet; both curves extended beyond limits noted. Gage read twice daily to hundredths. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Little Coal River at McCorkle, W. Va., during the year ending Sept. 30, 1917.

[Made by F. Conklin.]

Date.	Gage height.	Dis-charge.
	Feet.	*Sec.-ft.*
Mar. 14	8.95	4,610
15	6.22	2,440
June 7	3.42	520

Daily discharge, in second-feet, of Little Coal River at McCorkle, W. Va., for the years ending Sept. 30, 1915–1917.

Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.
1915.				1915.				1915.			
1		84	5	11		28	17	21		9	8
2		90	4	12		24	12	22		8	12
3		178	6	13		36	8	23	272	7	26
4		492	60	14		29	7	24	191	6	13
5		235	181	15		19	6	25	135	5	8
6		126	178	16		16	5	26	96	5	6
7		96	132	17		43	4	27	78	4	6
8		58	78	18		55	5	28	40	5	34
9		40	46	19		11	5	29	26	5	7
10		29	26	20		10	4	30	22	8	7
								31	58	5	

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915-16.												
1	2,320	7	138	750	3,930	470	538	515	63	58	5	22
2	750	6	132	605	2,780	700	492	450	40	43	4	31
3	390	6	120	492	1,330	1,460	515	370	38	43	4	58
4	350	6	111	430	900	1,140	410	450	117	34	5	40
5	228	6	102	390	800	900	370	390	81	25	6	31
6	181	5	87	515	1,530	800	330	370	58	16	43	23
7	138	5	72	750	2,090	2,090	310	370	291	11	164	17
8	102	5	72	605	1,200	3,020	560	410	310	8	132	14
9	78	6	72	650	1,460	1,200	1,740	370	224	8	4,440	29
10	58	6	58	850	1,460	750	1,080	330	191	8	8,150	15
11	40	5	43	4,100	1,080	560	1,460	310	164	7	1,370	10
12	28	6	60	3,420	750	430	1,600	254	142	7	700	8
13	22	15	96	2,860	900	390	1,020	224	102	6	1,510	7
14	19	49	102	1,740	650	390	700	181	78	14	1,370	6
15	13	1,740	58	850	605	370	515	154	81	8	702	330
16	12	900	126	650	560	350	410	148	87	87	2,620	182
17	9	470	1,810	560	515	330	390	142	126	102	5,000	107
18	15	310	6,690	350	450	350	310	126	117	123	1,510	58
19	58	272	2,620	390	470	370	272	93	228	117	620	20
20	72	310	1,020	430	430	350	254	72	254	22	430	15
21	66	310	560	430	430	410	235	66	174	142	330	14
22	43	272	410	515	430	450	272	63	123	81	255	11
23	29	235	330	1,200	430	470	254	72	87	96	220	9
24	22	195	272	1,020	450	390	235	72	55	52	174	7
25	17	167	235	650	960	370	330	52	87	31	120	6
26	16	145	450	515	1,460	350	370	34	55	17	85	5
27	16	132	470	430	960	960	450	34	224	11	72	5
28	11	161	650	390	650	1,880	850	24	164	8	69	5
29	10	164	4,270	430	560	1,400	1,080	58	111	6	60	5
30	9	164	3,100	850		900	700	117	72	6	43	4
31	8		1,260	850		650		117		6	31	

Daily discharge in second-feet, of Little Coal River at McCorkle, W. Va., for the years ending Sept. 30, 1915–1917—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1916-17.												
1	4.3	14	160	538	850	4,150	455	702	850	38	12	8.6
2	3.8	17	147	455	1,160	3,180	430	565	2,540	29	9.8	5.5
3	3.8	14	120	510	790	7,040	405	455	4,740	103	8.6	4.5
4	3.5	13	116	730	850	5,340	315	405	1,650	125	147	3.8
5	3.4	10	220	2,390	1,370	3,980	355	405	850	57	49	3.8
6	3.2	8	192	4,580	1,370	2,240	2,320	340	620	29	23	3.5
7	3.0	8	174	2,090	1,370	2,860	2,240	310	482	38	18	3.2
8	3.2	7	160	1,100	1,300	5,850	1,790	330	380	205	19	1,230
9	4	6.6	160	760	1,230	3,260	1,300	790	335	148	94	3,500
10	11	11	160	592	675	1,650	850	910	482	103	63	1,650
11	15	63	147	510	850	1,040	648	702	592	49	29	538
12	23	14	116	355	482	4,150	538	790	565	29	15	355
13	15	36	138	355	405	5,170	510	730	430	15	9.5	205
14	10	17	43	510	510	4,660	482	648	380	23	7	147
15	8	23	52	1,040	620	2,320	405	538	330	76	13	72
16	10	26	52	970	1,440	1,370	355	455	240	72	9.5	58
17	10	23	116	790	970	1,510	315	380	192	160	6.4	34
18	26	22	72	592	850	1,940	290	315	147	205	5.2	26
19	160	22	43	565	850	1,230	280	280	129	169	4.4	23
20	240	8	94	538	1,370	850	255	215	151	125	3.8	26
21	220	10	420	702	2,940	1,230	235	182	98	72	3.6	26
22	147	11	1,940	5,000	1,440	1,440	230	160	81	63	3.4	38
23	103	14	1,300	2,700	970	1,440	205	169	66	192	3.8	29
24	72	52	675	1,230	5,170	5,340	192	147	43	245	4.5	17
25	63	116	510	910	3,100	3,020	182	103	116	235	4.2	14
26	58	116	380	675	1,580	1,510	265	81	76	125	4.0	10
27	43	94	380	648	970	1,040	240	2,390	43	60	3.6	11
28	26	94	1,790	510	3,420	790	205	6,700	43	43	3.4	43
29	26	138	3,020	538	....	675	675	4,660	125	38	5.7	355
30	23	160	1,100	760	....	620	850	2,020	94	24	10	220
31	17	....	648	760	....	510	....	970	....	17	8	....

Monthly discharge of Little Coal River at McCorkle, W. Va., for the years ending Sept. 30, 1915–1917.

[Drainage area, 375 square miles.]

Month.	Discharge in second-feet. Maximum.	Minimum.	Mean.	Per square mile.	Run-off (depth in inches on drainage area).
1915.					
July 23-31	272	22	102	0.272	0.09
August	492	4	57	.152	.18
September	181	4	30.5	.0813	.09
1915-16.					
October	2,320	8	165	0.440	.51
November	1,740	5	203	.541	.60
December	6,690	43	826	2.20	2.54
January	4,100	350	925	2.47	2.85
February	3,930	430	1,040	2.77	2.99
March	3,020	330	795	2.12	2.44
April	1,740	235	602	1.61	1.80
May	515	24	208	.555	.64
June	310	38	131	.349	.39
July	142	6	38.8	.103	.12
August	8,150	4	976	2.60	3.00
September	330	4	36.5	.097	.11
The year	8,150	4	495	1.32	17.99
1916-17.					
October	240	3	43.8	0.117	0.13
November	160	6.6	38.9	.104	.12
December	3,020	43	473	1.26	1.45
January	5,000	355	1,110	2.96	3.41
February	5,170	405	1,390	3.71	3.86
March	7,040	510	2,630	7.01	8.08
April	2,320	182	594	1.58	1.76
May	6,700	81	898	2.39	2.76
June	4,740	43	562	1.50	1.67
July	245	15	93.9	.250	.29
August	147	3.4	19.4	.052	.06
September	3,500	3.2	289	.771	.86
The year	7,040	3	676	1.80	24.45

RACCOON CREEK BASIN.

RACCOON CREEK AT ADAMSVILLE, OHIO.

Location.—About 200 feet above covered highway bridge at Adamsville, Gallia County, 5 miles southwest from Hocking Valley Railroad station at Bidwell. Indian Creek enters on right 1¼ miles above station.

Drainage area.—537 square miles (measured on topographic maps).

Records available.—June 25, 1915, to September 30, 1917.

Gage.—Vertical and inclined staff on left bank 200 feet above bridge; read by Irene Call

Discharge measurements.—Made from covered highway bridge or by wading.

Channel and control.—Straight for about 500 feet above and 600 feet below bridge. Bed of stream composed of mud, sand, and gravel. Principal control at ruins of old mill dam 1,200 feet below bridge; probably permanent.

Extremes of discharge.—Maximum stage recorded during year, 17.9 feet March 14 (discharge, 6,300 second-feet); minimum stage recorded, 1.75 feet at 7 a. m. September 26 (discharge, 18 second-feet).

High-water marks indicate maximum stage of about 24.5 feet.

Ice.—Stage-discharge relation affected by ice during severe winters.

Accuracy.—State-discharge relation practically permanent; affected by ice December 15–21, February 5–13, and probably to some extent January 16–20. Rating curve well defined between 70 and 5,800 second-feet; beyond these limits, the curve is an extension. Gage read twice daily to hundredths. Daily discharge ascertained by applying mean daily gage height to rating table, except for ice periods, for which it is estimated from climatic data. Open-water records excellent; ice records poor.

Cooperation.—Base data furnished by United States Engineer Corps.

Daily discharge, in second-feet, of Raccoon Creek at Adamsville, Ohio, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	39	46	87	797	2,430	1,150	478	632	3,720	404	109	58
2	37	42	87	552	1,280	1,080	632	527	2,520	208	100	68
3	44	55	80	1,560	742	1,080	1,050	502	3,580	128	73	60
4	44	44	76	2,180	478	1,480	1,310	404	2,790	128	77	52
5	35	49	109	2,520		1,850	1,280	308	2,010	148	84	47
6	35	50	92	2,790		1,560	3,060	308	1,180	109	84	57
7	35	42	118	2,880		1,410	3,430	296	1,020	632	73	84
8	37	42	138	2,260		2,650	3,290	250	909	2,350	71	84
9	36	45	138	1,280	250	3,480	2,740	218	1,020	1,280	64	58
10	39	52	109	527		4,000	1,450	208	1,410	1,020	68	65
11	42	56	109	605		4,390	966	188	1,520	478	66	58
12	39	55	97	478		5,680	797	178	1,380	332	64	55
13	36	52	94	332		5,990	632	158	1,120	228	58	46
14	37	50	84	380	168	6,310	527	158	659	228	49	45
15	39	55		578	188	5,790	429	138	478	1,340	46	49
16	43	58		632	188	4,590	380	158	356	552	50	44
17	62	62		527	188	2,470	356	128	272	332	48	40
18	62	58	50	478	239	2,140	284	100	218	527	56	39
19	332	55		429	356	1,810	380	95	198	714	43	36
20	188	47		356	502	1,480	966	95	198	1,150	45	36
21	188	47		797	429	1,150	687	90	178	502	39	36
22	208	48	478	6,150	380	1,120	478	94	148	687	56	42
23	138	64	578	6,100	797	1,280	356	168	308	502	45	36
24	118	92	632	5,530	2,610	3,720	284	168	453	261	44	30
25	81	92	128	4,750	2,700	3,950	261	118	272	208	45	23
26	73	70	70	3,580	1,820	3,340	332	95	188	178	34	21
27	89	100	2,050	1,280	1,080	1,630	296	3,620	118	218	35	39
28	77	89	3,860	1,150	1,020	1,150	284	5,790	118	332	39	39
29	57	78	4,000	2,010	......	881	478	5,840	261	332	42	39
30	59	84	3,720	2,880	......	687	659	5,010	208	188	38	34
31	64	......	2,930	3,200	......	552	......	4,290	......	178	78	......

Note.—Daily discharge estimated, because of ice, from climatic data, Dec. 15–21, Feb. 5–13. Braced figures show mean discharge for periods included. Daily discharge interpolated because of missing gage readings Mar. 18–20.

Monthly discharge of Raccoon Creek at Adamsville, Ohio, for the year ending Sept. 30, 1917.

[Drainage area, 537 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	332	35	77.8	0.145	0.17
November	100	42	59.3	.110	.12
December	4,000	....	652	1.21	1.40
January	6,150	332	1,920	3.58	4.13
February	2,700	....	709	1.32	1.38
March	6,310	552	2,580	4.80	5.53
April	3,430	261	952	1.77	1.98
May	5,840	90	978	1.82	2.10
June	3,720	118	960	1.79	2.00
July	2,350	109	512	.953	1.10
August	109	34	58.8	.109	.13
September	84	21	47.3	.088	.10
The year	6,310	21	796	1.48	20.14

GUYANDOT RIVER BASIN.

GUYANDOT RIVER AT WILBER, W. VA.

LOCATION.—At site of Hutchinson Lumber Co.'s suspension bridge at Wilber, three-fourths mile below Manbar, Logan County. Rich Creek enters river on left about 600 feet above station.

DRAINAGE AREA.—791 square miles (measured on map of West Virginia, scale 1:500,-000).

RECORDS AVAILABLE.—July 13, 1915, to September 30, 1917.

GAGE.—Vertical and inclined staff on right bank; read by Allie Smith. Vertical section fastened to downstream corner of right timber crib pier; inclined section is about 10 feet downstream.

DISCHARGE MEASUREMENTS.—Made from cable installed between towers of former bridge in February, 1916, or by wading.

CHANNEL AND CONTROL.—Straight for about 1,000 feet above and 500 feet below station. Bed of river composed of solid rock, boulders, and mud; control probably permanent. Point of zero flow, gage height 0.00 ± 0.5 foot.

EXTREMES OF STAGE.—Maximum stage recorded, 17.0 feet at 5 p. m. March 4; minimum, 1.10 feet September 26.

Highest flood known reached a stage represented by gage height about 24 feet.

ICE.—Stage-discharge relation probably not affected by ice except in severe winters.

ACCURACY.—Stage-discharge relation probably permanent; probably affected by ice to some extent during December and February. Rating curve not yet determined. Gage read twice daily. Records excellent.

COOPERATION.—Base data furnished by United States Engineer Corps.

Daily gage height, in feet, of Guyandot River at Wilber, W. Va., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	4.00	2.31	2.60	4.31	6.95	6.80	4.20	3.05	4.05	2.05	2.87	3.10
2	3 55	2.29	2.55	3.81	7.50	6.80	3.85	3.15	5.05	2.02	3.00	2.62
3	2.93	2.25	2.77	3.90	8.45	12.00	3.10	3.07	6.00	1.95	2.50	2.43
4	2.65	2.17	2.77	5.90	7.40	15.25	3.05	3 15	5.05	1.80	2.30	2 42
5	2.48	2.15	2.80	11.50	4.35	13.50	3.20	3.40	5.02	1.75	2.60	2.32
6	2.34	2.07	2.75	10.40	5.30	9.50	5.20	3.12	4.05	1.85	2.85	2.10
7	2.23	2.05	2.70	7.90	5.35	7.30	5.05	3.02	3.80	1.92	2.05	2.30
8	2.14	2.03	2.65	5.86	4.55	6.20	4.80	3.07	3.85	2.02	2.15	4.12
9	2.10	2.00	2.70	4.50	4.30	5.20	6.20	3.06	5.05	1.92	3.02	7.00
10	2.10	2.05	2.75	3.80	3.80	5.10	5.30	3.15	3.65	1.80	2.80	5.85
11	2.08	2.06	2.69	3.80	4.00	5.80	5.05	3.50	4.05	1.92	2.30	4.45
12	2.05	2.18	2.67	3.50	3.30	6.70	4.05	3.70	3.05	1.97	2.05	3.20
13	2.05	2.35	2.60	3.00	3.30	8.30	4.05	3.50	3.02	1.97	2.00	2.70
14	1.99	2.31	2.61	3.80	3.30	9.50	3.70	3.02	2.95	2.05	2.07	2.62
15	1.90	2.31	2.70	3.80	4.30	7.60	3.70	3.25	3.02	2.02	1.95	2.42
16	1.95	2.30	2.61	4.30	4.30	6.45	3.70	3.32	2.95	3.05	1.90	2.45
17	2.44	2.28	2.55	3.80	4.80	7.60	4.05	3.22	3.02	4.05	1.95	2.32
18	3.55	2.23	2.55	4.15	4.45	7.80	3.05	3.35	2.97	4.30	1.82	2.15
19	4.25	2.23	2.65	3.80	4.80	6.55	3.25	3.40	3.05	3.05	1.92	1.90
20	4.53	2.22	2.75	3.80	6.80	6.55	3.30	3.30	2.90	3.02	1.85	1.80
21	4.00	2.18	2.83	3.80	6.30	5.50	3.15	3.42	3.02	3.02	1.87	1.65
22	3.73	2.18	4.95	9.50	4.80	6.30	3.02	3.32	2.80	3.15	1.95	1.45
23	3.39	2.20	7.10	9.25	5.00	11.50	3.05	3.22	2.22	3.10	1.82	1.40
24	2.93	2.21	4.75	6.25	11.50	13.00	3.07	3.21	2.02	4.05	1.42	1.20
25	2.75	2.18	4.25	5.00	12.30	8.90	3.07	3.07	2.05	3.02	1.22	1.20
26	2.63	2.20	3.65	4.50	9.45	8.65	3.02	3.01	2.00	3.00	1.80	1110
27	2.52	2.33	3.40	3.80	8.30	7.30	3.00	3.02	2.07	2.90	1.22	1.65
28	2.43	2.38	7.26	3.30	7.50	6.30	3.05	6.33	2.02	2.20	1.50	4.82
29	2.36	2.40	9.64	4.30	....	6.05	3.02	6.85	2.03	3.02	1.60	3.80
30	2.30	2.39	6.36	5.00	....	5.60	3.02	5.30	2.52	3.00	1.87	3.42
31	2.29	....	5.65	5.50	....	5.05	....	4.85	....	2.80	2.22	....

GUYANDOT RIVER AT BRANCHLAND, W. VA.

Location.—At highway bridge at Branchland, Lincoln County. Fourmile Creek enters river on left about 20 feet above bridge.

Drainage area.—1,230 square miles (measured on map of West Virginia, scale 1:500,000).

Records available.—July 8, 1915, to September 30, 1917.

Gage.—Chain gage fastened to handrail on upstream side of bridge near center of main span; read by John A. Broaddus.

Discharge measurements.—Made from bridge or by wading.

Channel and control.—Bed of stream is composed of rock, gravel, sand, and mud and is fairly permanent; character of control not determined.

Extremes of discharge.—Maximum stage recorded during year, 31.3 feet at noon March 5 (discharge, about 30,000 second-feet); minimum, 2.76 feet August 21 (discharge, about 53 second-feet).

Highest flood known reached a gage height of about 44 feet by present gage.

Ice.—Stage-discharge relation affected by ice during cold winters.

Accuracy.—Stage-discharge relation may change during floods; affected by ice December 14–20, February 6–16. Rating curve well defined between 280 and 25,000 second-feet; beyond these limits the curve is an extension. Gage read twice daily to hundredths. Daily discharge ascertained by applying mean daily gage height to rating table except for periods affected by ice or missing gage readings. Records good except those estimated, which are poor.

Cooperation.—Base data furnished by United States Engineer Corps.

Discharge measurements of Guyandot River at Branchland, W. Va., during the year ending Sept. 30, 1917.

[Made by F. Conklin.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 30	12.26	7,140	Mar. 3	24.32	22,800
Jan. 6	21.85	18,100	17	9.96	5,220

Daily discharge, in second-feet, of Guyandot River at Branchland, W. Va., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		176	320	2,220	2,900	8,710	1,590	1,170	3,400	156	212	244
2		168	370	1,520	6,500	15,300	1,520	1,100	5,100	111	141	320
3		172	395	1,590	5,460	20,500	1,310	1,030	6,610	105	126	345
4		168	370	2,140	2,900	24,600	1,100	960	4,760	105	196	248
5		159	530	12,700	2,060	29,100	1,310	960	2,560	126	240	224
6		141	445	18,100		16,200	4,420	960	1,590	100	240	208
7		129	395	11,700		9,020	6,720	890	1,240	85	276	252
8		98	370	5,640		10,800	5,100	830	960	80	220	2,220
9	70	114	370	3,320		8,290	5,020	1,030	770	370	264	5,370
10		141	345	2,220		5,910	3,660	1,740	830	220	268	6,000
11		141	345	1,660	1,500	4,940	2,380	2,140	1,170	179	304	2,640
12		135	320	1,310		7,030	1,740	1,980	1,310	162	260	1,170
13		132	320	960		13,200	1,520	1,590	960	141	216	740
14		156		1,170		15,500	1,310	1,310	770	126	179	530
15		193		1,660		10,200	1,100	1,100	650	135	150	420
16		179		1,900		6,000	960	960	530	272	132	345
17	126	176	225	1,740	4,850	5,370	830	770	445	560	98	280
18	179	176		1,380	2,560	11,300	740	680	395	1,100	85	268
19	740	176		1,310	2,300	7,660	680	590	320	1,030	70	232
20	1,590	159		1,310	3,320	4,600	620	500	300	890	60	196
21	1,380	153	650	2,640	11,500	4,260	590	445	252	740	55	260
22	960	150	1,740	9,130	7,870	4,170	560	395	228	530	62	228
23	710	156	4,850	12,200	4,510	4,680	500	395	212	420	85	182
24	680	172	4,340	6,200	10,200	12,800	470	395	193	620	141	159
25	395	200	2,060	3,660	16,800	20,000	445	370	186	1,820	147	138
26	370	193	1,380	2,380	8,400	9,020	445	320	156	1,170	236	126
27	300	200	1,100	1,660	4,680	4,940	470	1,460	144	710	196	138
28	280	228	7,560	1,380	6,720	3,740	445	6,720	156	500	176	248
29	236	276	15,100	1,310	....	3,060	770	9,660	470	445	156	1,520
30	220	300	8,180	1,590	....	2,560	1,100	6,610	268	320	153	960
31	204	....	4,200	2,380	....	2,060	....	3,580	....	260	193	....

NOTE.—Daily discharge estimated because of ice or missing gage readings from observer's notes, climatic data, or by comparison with flow at other stations, Oct. 1-16, Dec. 14-20, 31, Feb. 6-16. Braced figures are the means for the periods indicated.

Monthly discharge of Guyandot River at Branchland, W. Va., for the year ending Sept. 30, 1917.

[Drainage area, 1,230 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	....	....	306	0.249	0.29
November	300	98	171	.139	.16
December	15,100	....	1,860	1.51	1.74
January	18,100	960	3,870	3.15	3.63
February	16,800	....	4,290	3.49	3.63
March	29,100	2,060	9,860	8.02	9.25
April	6,720	445	1,650	1.34	1.50
May	9,660	320	1,700	1.38	1.59
June	6,610	144	1,230	1.00	1.12
July	1,820	80	438	.356	.41
August	304	55	172	.140	.16
September	6,000	126	874	.711	.79
The year	29,100	....	2,200	1.79	24.27

MUD RIVER AT YATES, W. VA.

LOCATION.—About 200 feet above highway bridge at Yates, Cabell County, 2 miles above Howell mill dam, and 15 miles from Huntington.

DRAINAGE AREA.—318 square miles (measured on topographic maps).

RECORDS AVAILABLE.—July 19, 1915, to September 30, 1917.

GAGE.—Vertical and inclined staff on left bank, read by C. J. McDonie.

DISCHARGE MEASUREMENTS.—Made from single-span steel highway bridge below gage.

CHANNEL AND CONTROL.—One channel up to high stages, when right bank overflows around right abutment; straight for about 50 feet above and 75 feet below bridge. Primary control at ford, about 100 feet below gage; fairly permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 16.80 feet at 5 p. m. March 14 (discharge, 5,980 second-feet); minimum is not definitely known as sandbar formed around gage during low water period.

Highest flood known reached a gage height of about 23 feet by present gage.

ICE.—Stage-discharge relation affected by ice during severe winters.

ACCURACY.—Stage-discharge relation probably permanent; affected by ice January 14–20 and February 3–11. Rating curve well defined between 14 and 5,500 second-feet; extended beyond these limits. Gage read twice daily to hundredths. Daily discharge ascertained by applying mean daily gage height to rating table, except during periods stage-discharge relation was affected by ice. Records good except for periods for which discharge was estimated on account of ice or missing gage readings, for which they are poor.

COOPERATION.—Base data furnished by United States Engineer Corps.

Discharge measurements of Mud River at Yates, W. Va., during the year ending Sept. 30, 1917.

[Made by F. Conklin.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Feb. 24	11.43	3,010
May 29	16.25	5,670

Daily discharge, in second-feet, of Mud River at Yates, W. Va., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	28	30	116	272	785	4,500	187	154	595	62	13	
2	27	21	83	232	648	2,640	178	130	1,280	45	14	
3	25	20	72	1,320		2,980	187	95	2,060	34	13	
4	19	19	62	1,660		4,230	170	83	813	25	7.4	3.0
5	14	19	493	1,820		2,830	283	78	371	20		
6	9.5	18	493	2,460		1,460	2,510	78	252	20	7	
7	10	17	213	1,080	200	2,060	2,280	78	569	40		49
8	8.3	16	146	543		3,740	813	72	213	28	89	232
9	8.9	14	108	371		3,330	518	116	222	20	53	443
10	9.5	20	89	283		1,080	371	170	187	26	22	170
11	14	26	89	213		648	272	123	138	24	18	146
12	14	34	89	162	38	2,600	222	130	162	22	14	102
13	11	27	78	130	23	4,230	204	162	123	20	11	52
14	8.3	31	59		146	5,860	187	123	95	19		30
15	9.5	32	46		162	3,740	162	95	78	25		25
16	10	29	55	200	283	935	130	83	67	21		25
17	10	28	59		595	1,500	116	72	61	26		24
18	12	26	45		1,660	1,500	108	62	58	26		23
19	116	24	52		813	813	95	57	51	29		20
20	272	21	58		729	518	89	51	50	27		16
21	154	22	785	1,360	1,220	1,320	83	47	67	23		16
22	108	24	2,380	5,680	595	2,460	78	44	58	49	3.5	18
23	78	26	1,220	4,450	675	1,000	72	138	47	36		17
24	59	37	468	842	2,980	3,630	67	58	41	518		16
25	49	36	327	518	3,080	3,840	67	46	35	146		13
26	41	45	242	394	842	872	62	40	32	72		11
27	38	44	294	327	970	569	58	3,130	35	45		8.6
28	34	48	2,380	349	2,880	468	58	5,320	34	34		14
29	39	51	3,030	468	......	349	95	5,560	130	28		15
30	32	116	757	595	......	262	222	2,060	72	21		15
31	28	......	394	443	......	213	......	543	......	16		......

NOTE.—Discharge estimated because of ice or missing gage readings from observer's notes and climatic records as follows: Jan. 14-20; Feb. 3-11; Aug. 5-7, 14-31, and Sept. 1-6. Braced quantities represent mean discharge for the period included.

Monthly discharge of Mud River at Yates, W. Va., for the year ending Sept. 30, 1917.

[Drainage area, 318 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	272	8.3	41.8	0.131	0.15
November	116	14	30.7	.096	.11
December	3,030	45	477	1.50	1.73
January	5,680	....	883	2.78	3.20
February	3,080	23	747	2.35	2.45
March	5,860	213	2,130	6.70	7.72
April	2,510	58	331	1.04	1.16
May	5,560	40	613	1.93	2.22
June	2,060	32	266	.836	.93
July	518	16	49.9	.157	.18
August	89	....	10.9	.034	.04
September	443	....	50.6	.159	.18
The year	5,860	....	471	1.48	20.07

TWELVEPOLE CREEK BASIN.

TWELVEPOLE CREEK AT WAYNE, W. VA.

LOCATION.—At highway bridge, 500 feet above railroad bridge of East Lynne branch of Norfolk & Western Railway at Wayne, Wayne County, about three-fourths mile below junction of East and West forks.

DRAINAGE AREA.—291 square miles (measured on topographic maps).

RECORDS AVAILABLE.—July 1, 1915, to September 30, 1917.

GAGE.—Chain gage attached to upstream handrail about 90 feet from left abutment; read by Bryon Smith.

DISCHARGE MEASUREMENTS.—Made from highway bridge or by wading.

CHANNEL AND CONTROL.—Straight for about 80 feet above and 1,200 feet below bridge. Bed of stream composed of rock and sand. Principal control is Sampson's milldam; probably permanent, but at low stages the operation of the mill may affect the discharge relation.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 15.25 feet at 8.30 a. m. January 22 (discharge, 5,140 second-feet); minimum, 1.18 feet August 2, 8, and 29 (discharge, about 5 second-feet).

Highest flood known reached a stage represented by gage height about 25 feet.

ICE.—Stage-discharge relation probably not materially affected by ice.

REGULATION.—None, except for backwater caused during low water periods by operation of small power plant at Sampson's mill about a mile below gage.

ACCURACY.—Stage-discharge relation probably permanent; slightly affected by ice January 14–20 and February 3–11. Operation of power plant at dam about a mile below gage may have slight effect upon stage-discharge relation at low stages, but this effect, if any, is small as the plant is only operated occasionally for a few hours at a time. Rating curve well defined beween 139 and 6,700 second-feet, fairly well defined between 29 and 139 second-feet; extended beyond these limits. Gage read twice daily to hundredths. Daily discharge ascertained by applying mean daily gage height to rating table. Open-water records good; ice records poor.

COOPERATION.—Base data furnished by United States Engineer Corps.

Discharge measurements of Twelvepole Creek at Wayne, W. Va., during the year ending Sept. 30, 1917.

[Made by F. Conklin.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Jan. 22	14.64	4,820
23	8.38	1,710
Mar. 25	7.78	1,660

Daily discharge, in second-feet, of Twelvepole Creek at Wayne, W. Va., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	14	28	57	349	809	2,780	285	226	657	80	14	7.2
2	16	26	60	306	521	1,600	226	226	2,500	57	13	7.6
3	16	24	56	809	418	3,970	226	208	2,060	38	13	7.2
4	16	21	37	1,020	394	3,220	156	123	875	29	13	11
5	15	20	34	1,780	394	1,740	809	123	443	27	17	9
6	16	19	36	2,010	371	1,240	2,190	93	327	25	32	7.6
7	16	18	34	1,830	371	1,740	1,320	111	394	30	14	13
8	14	17	33	1,320	371	3,570	1,090	116	226	49	10	573
9	13	20	108	777	327	2,140	1,050	131	190	83	8.8	944
10	12	21	111	327	306	1,240	746	190	190	30	7.4	418
11	12	20	94	236	285	777	495	265	156	28	28	164
12	11	19	83	182	265	4,120	327	306	131	25	20	131
13	18	19	70	190	217	3,320	265	226	94	22	18	108
14	24	21	57	208	199	3,170	306	190	68	21	17	94
15	17	21	55	285	418	1,560	116	139	58	29	16	84
16	19	22	55	255	746	944	131	108	53	30	13	63
17	22	21	55	226	1,090	1,320	199	94	52	75	8.4	36
18	23	18	55	208	842	1,090	164	68	108	84	6.2	20
19	265	18	55	265	979	1,050	190	58	78	58	6.0	15
20	255	19	55	327	1,320	1,050	108	59	55	41	5.8	15
21	182	20	716	1,320	777	2,100	94	50	46	469	5.6	31
22	131	23	573	4,770	657	1,020	94	35	37	31	5.2	23
23	94	37	573	1,700	979	875	90	49	34	28	5.2	21
24	58	37	394	686	3,620	5,020	87	48	34	27	5.4	19
25	51	41	327	418	1,700	1,830	79	48	30	87	5.4	16
26	44	42	226	285	1,130	944	74	48	28	50	5.0	15
27	37	41	255	255	842	628	69	777	28	38	5.2	16
28	35	43	2,100	327	2,870	495	65	4,170	56	32	4.9	21
29	33	49	1,480	285	....	349	67	1,880	38	24	4.8	43
30	32	56	600	349	....	285	94	809	116	15	8.8	56
31	30	....	394	327	....	285	....	443	....	14	8.6	....

Monthly discharge of Twelvepole Creek at Wayne, W. Va., for the year ending Sept. 30, 1917.

[Drainage area, 291 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	265	11	49.7	0.171	0.20
November	56	17	26.7	.092	.10
December	2,100	33	285	.979	1.13
January	4,770	182	762	2.62	3.02
February	3,620	199	829	2.85	2.97
March	5,020	285	1,790	6.15	7.09
April	2,190	65	374	1.29	1.44
May	4,170	35	368	1.26	1.45
June	2,500	28	305	1.05	1.17
July	469	14	52.5	.180	.21
August	32	4.8	11.1	.038	.04
September	944	7.2	99.6	.342	.38
The year	5,020	4.8	412	1.42	19.20

BIG SANDY RIVER BASIN.

LEVISA FORK AT THELMA, KY.

Location.—At Chesapeake & Ohio Railway bridge at Thelma, Johnston County, 2 miles below Paintsville. Buffalo Creek enters on right about half a mile above station.

Drainage area.—2,090 square miles (measured by United States Engineer Corps).

Records available.—June 1, 1915, to September 30, 1917.

Gage.—Vertical staff gage attached to right shore pier of bridge, portion of gage above 24 feet is cut in masonry steps on upper end of right abutment; read by John Stambaugh. Sea-level elevation of gage, 561.82 feet (United States Engineer Corps).

Discharge measurements.—Made from boardwalk constructed on the lower downstream chord of bridge.

Channel and control.—Channel straight one-half mile above and 300 feet below gage. Bed of stream sandy. Remains of coffer dams around piers, and piles at measuring section. Primary control about 2,400 feet downstream composed of rock which extends three-fourths of the way across stream; remainder is firm sand, fairly permanent.

Extremes of stage.—Maximum, mean gage height during year, 33.85 feet March 5; minimum, mean gage height, 1.50 feet October 14–16. Highest stage recorded, 42.6 feet by present gage.

Ice.—Stage-discharge relation probably not affected by ice.

Regulation.—Splash dams on tributaries and in main stream about 50 miles above used by timber companies may affect low-water flow to some extent.

Accuracy.—Discharge measurements made in 1917 apparently indicate a marked change in stage-discharge relation; additional measurements are needed for confirmation before making a new rating table. Gage read twice daily to hundredths below 10 feet and to tenths above 10 feet. Records good.

Cooperation.—Base data furnished by United States Engineer Corps.

Discharge measurements of Levisa Fork at Thelma, Ky., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 29	F. C. Sammons......	20.25	24,400	Mar. 3	H. E. Frye..........	29.10	44,400
29	.....do..............	20.40	22,100	4	.....do..............	32.25	44,000
Jan. 6	.....do..............	29.70	41,800	4	.....do..............	31.70	45,300
6	.....do..............	27.60	45,700	5	.....do..............	34.05	51,200
7	.....do..............	20.30	20,100	5	.....do..............	22.90	23,300
7	.....do..............	28.50	37,500	5	.....do..............	34.10	54,200
Feb. 25	H. E. Frye..........	21.00	21,500	6	.....do..............	25.70	26,500
Mar. 3	.....do..............	27.10	35,300	6	.....do..............	21.65	19,900
3	.....do..............	28.05	38,300	20	Frye and Sammons..	10.6	7,310
3	.....do..............	29.20	41,300				

Daily gage height, in feet, of Levisa Fork at Thelma, Ky., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.65	2.10	2.57	6.30	9.30	13.50	6.55	4.37	3.55	3.30	2.67	4.10
2	1.69	2.10	2.60	5.45	15.25	23.60	6.30	5.02	5.50	2.80	2.55	6.15
3	1.99	2.05	2.70	5.75	11.50	28.60	6.40	5.10	6.13	2.47	2.62	4.80
4	1.97	2.00	2.77	12.65	7.75	32.20	5.90	4.65	5.25	2.65	3.17	3.30
5	1.85	1.98	3.00	27.90	6.90	33.85	5.75	4.25	3.98	3.40	2.95	2.92
6	1.72	1.95	3.10	28.06	5.77	23.25	10.55	4.10	3.55	3.42	2.75	2.57
7	1.64	1.90	2.90	18.65	5.47	15.65	13.05	4.00	3.68	2.92	2.37	2.85
8	1.57	1.85	2.82	11.70	5.45	16.60	10.95	3.78	3.33	2.27	2.42	3.85
9	1.50	1.80	2.87	8.55	5.17	13.95	9.20	3.78	3.45	2.10	3.35	4.95
10	1.65	1.87	2.67	6.85	5.40	11.25	8.00	4.15	3.35	2.65	3.62	4.75
11	1.56	1.95	2.67	5.90	7.07	9.30	6.45	4.90	3.57	2.60	3.80	4.17
12	1.51	1.95	2.70	5.10	6.80	11.50	5.65	4.95	3.75	2.25	3.15	3.50
13	1.51	1.97	2.70	4.55	5.85	18.75	5.35	4.85	3.50	2.12	2.67	3.05
14	1.50	2.25	2.50	4.60	5.80	16.25	5.23	4.58	3.38	2.05	2.50	2.75
15	1.50	2.32	2.30	5.25	6.45	13.30	5.10	4.25	3.10	2.10	2.30	2.47
16	1.50	2.27	2.50	6.80	9.07	10.97	4.83	3.90	2.85	2.37	2.25	2.32
17	1.62	2.20	2.50	6.50	7.95	14.30	4.55	3.65	2.60	2.45	2.22	2.15
18	2.55	2.20	2.77	5.72	7.40	18.70	4.33	3.45	2.50	3.05	2.12	2.06
19	5.15	2.20	2.45	5.50	7.05	13.60	4.05	3.25	2.53	3.45	1.97	2.00
20	6.30	2.20	2.40	5.90	11.75	10.45	3.93	3.05	3.65	3.52	1.90	1.87
21	6.45	2.15	3.25	6.67	22.25	9.50	3.83	2.93	2.63	3.67	1.77	1.81
22	4.70	2.10	6.30	16.00	15.50	9.90	3.68	2.80	2.38	2.65	1.75	1.82
23	3.89	2.05	9.55	14.40	11.20	10.15	3.55	2.95	2.30	3.20	2.15	1.72
24	3.35	2.12	9.05	11.77	17.90	20.30	3.43	3.03	2.30	4.47	3.05	1.65
25	3.00	2.15	6.10	9.05	20.50	23.95	3.28	2.93	2.45	5.90	3.06	1.60
26	2.75	2.15	4.92	7.25	14.80	15.45	3.25	2.83	2.43	5.85	2.85	1.60
27	2.52	2.15	4.35	6.00	10.75	11.20	3.13	3.75	2.30	5.37	2.62	1.65
28	2.37	2.17	8.95	5.52	11.75	10.50	3.23	9.45	2.45	4.57	2.27	4.62
29	2.27	2.40	19.70	5.17	......	10.25	3.48	6.60	2.30	4.27	2.07	6.20
30	2.20	2.47	13.75	5.85	......	9.07	3.95	4.80	3.58	3.35	2.00	5.50
31	2.17	......	8.50	7.17	......	7.75	......	4.08	......	3.05	2.30	......

TUG FORK AT KERMIT, W. VA.

Location.—About 150 feet above United Fuel Gas Co.'s ferry at Kermit, Mingo County. Marrowbone Creek enters on right about 2 miles below gage.

Drainage area.—1,240 square miles (measured by United States Engineer Corps).

Records available.—June 1, 1915, to September 30, 1917.

Gage.—Vertical staff gage in three sections attached to trees on right bank of river; 0–20 feet, 160 feet above cable; 20–38 feet, 130 feet below cable; and 38 to 48 feet at cable; read by C. C. Preece. Sea-level elevation of zero of gage, 574.77 feet (United States Engineer Corps).

Discharge measurements.—Made from car on ferry cable or by wading under cable.

Channel and control.—Channel straight above and below, bed of stream sandy; control about 150 feet below cable composed of solid rock which extends half way across from left bank and loose rock placed in river for fording, probably permanent.

Ice.—Stage-discharge relation rarely if ever affected by ice.

Accuracy.—Stage-discharge relation practically permanent; not affected by ice. Rating curve well defined between 85 and 25,000 second-feet; beyond these limits the curve is an extension. Gage read twice daily to hundredths below 10 feet and to tenths above 10 feet. Daily discharge ascertained by applying mean daily gage heights to rating table. Record excellent.

Cooperation.—Base data furnished by United States Engineer Corps.

Discharge measurements of Tug Fork at Kermit, W. Va., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 22	F. C. Sammons	13.3	9,290	Mar. 5	F. C. Sammons	30.70	35,800
Feb. 21	Frye and Sammons	16.45	12,100	5	....do	27.70	27,500
25	F. C. Sammons	17.90	15,700	23	Frye and Sammons	8.10	3,350
25	....do	17.35	14,200	24	....do	20.95	19,900
Mar. 3	....do	23.85	25,600	25	....do	21.85	18,800
3	....do	24.95	30,000	25	....do	20.80	18,200
3	....do	25.95	29,100	May 24	H. E. Frye	3.20	485
3	....do	26.55	28,400	24	....do	3.20	477

Daily discharge, in second-feet, of Tug Fork at Kermit, W. Va., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	990	195	400	1,900	5,100	8,260	2,360	1,220	1,220	290	245	780
2	572	195	400	1,470	9,820	20,000	2,120	1,100	1,540	208	220	880
3	365	185	400	2,600	5,100	26,000	1,820	1,100	2,760	185	382	490
4	275	185	400	6,000	3,320	28,000	1,540	990	1,900	275	595	335
5	208	175	435	19,800	2,360	34,300	1,750	1,100	1,540	220	595	260
6	185	155	452	17,800	1,610	12,400	6,970	1,220	880	245	335	232
7	208	155	400	8,860	1,680	7,190	6,750	1,100	730	220	290	435
8	140	140	365	5,100	1,540	11,100	4,700	990	572	195	350	830
9	132	140	350	3,480	1,470	7,420	3,640	1,220	530	220	640	1,340
10	148	165	335	2,520	1,160	5,600	2,840	2,040	730	155	290	1,040
11	140	175	320	2,040	1,220	4,340	2,280	2,200	990	185	730	640
12	132	155	365	1,470	1,100	5,800	1,900	1,820	880	232	470	435
13	148	232	335	1,280	880	12,900	1,750	1,540	640	155	350	320
14	140	260	305	1,470	990	11,300	1,540	1,280	550	155	275	260
15	125	260	305	1,470	1,540	7,900	1,400	1,100	572	220	208	208
16	132	260	335	1,680	2,840	5,700	1,280	935	382	335	195	185
17	165	275	305	1,680	3,480	8,860	1,100	830	335	595	220	175
18	595	245	275	1,540	2,840	11,300	935	685	305	780	148	232
19	1,680	245	335	1,610	2,680	6,750	1,100	595	275	780	148	148
20	1,900	232	418	1,540	5,500	4,700	830	530	290	830	148	125
21	1,470	220	382	2,200	15,000	3,980	830	550	260	685	132	132
22	880	208	1,470	9,820	7,190	3,890	780	530	220	510	118	110
23	595	208	5,900	7,660	4,520	4,070	730	530	232	550	132	95
24	452	232	3,240	5,400	13,500	19,000	685	490	220	1,040	155	102
25	382	232	1,820	3,560	15,400	18,300	640	418	208	1,100	490	110
26	320	220	1,280	2,600	8,140	7,540	685	365	185	1,040	435	118
27	275	245	990	1,970	4,340	5,100	640	830	232	880	290	140
28	245	245	4,070	1,680	4,700	4,520	595	3,000	232	530	208	1,540
29	220	320	14,700	1,470	......	4,070	935	3,980	232	490	165	1,750
30	208	365	5,900	2,440	......	3,480	1,220	2,200	220	382	260	1,040
31	195	......	3,000	2,840	......	3,160	......	1,280	......	320	220	......

Monthly discharge of Tug Fork at Kermit, W. Va., for the year ending Sept. 30, 1917.

[Drainage area, 1,240 square miles]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,900	125	439	0.345	0.41
November	365	140	217	.175	.20
December	14,700	275	1,610	1.30	1.50
January	19,800	1,280	4,100	3.31	3.82
February	15,400	880	4,610	3.72	3.87
March	34,300	3,160	10,200	8.23	9.49
April	6,970	595	1,880	1.52	1.70
May	3,980	365	1,220	.984	1.13
June	2,760	185	662	.534	.60
July	1,100	155	452	.365	.42
August	730	118	304	.245	.28
September	1,750	95	483	.390	.44
The year	34,300	95	2,180	1.76	23.86

BLAINE CREEK AT YATESVILLE, KY.

LOCATION.—At covered highway bridge one-fourth mile above Yatesville, Lawrence County. Morgan Branch enters on left about 2 miles above station.

DRAINAGE AREA.—216 square miles (United States Engineer Corps).

RECORDS AVAILABLE.—June 1, 1915, to September 30, 1917.

GAGE.—Vertical staff gage in two sections attached to elm tree on right bank about 50 feet above bridge; read by Hattie M. Carter.

DISCHARGE MEASUREMENTS.—Made from board walk constructed on inside of bridge near top of siding. Wading measurements are made under bridge.

CHANNEL AND CONTROL.—Stream curved above and straight below bridge, right bank overflows at high stages, stream bed compact sand and gravel; control composed of bed rock extending half way across stream, sand and gravel rest of way, probably permanent.

ICE.—Stage-discharge relation rarely affected by ice.

ACCURACY.—Stage-discharge relation probably permanent; not affected by ice. Rating curve well defined between 20 and 4,000 second-feet; extended beyond these limits. Gage read twice daily to hundredths below and tenths above 10 feet. Daily discharge ascertained by applying mean daily gage heights to rating table. Records good.

COOPERATION.—Base data furnished by United States Engineer Corps.

Discharge measurements of Blaine Creek at Yatesville, Ky., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 22	H. E. Frye	15.25	5,310	Mar. 12	Frye and Sammons	10.95	3,640
22	....do	15.40	5,440	19	....do	3.79	614
Feb. 24	....do	7.90	2,370	Apr. 26	H. E. Frye	1.81	73.7
Mar. 12	Frye and Sammons	10.91	3,620				

Daily discharge, in second-feet, of Blaine Creek at Yatesville, Ky., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	27	22	47	252	800	2,820	264	112	555	160	18	239
2	18	21	43	204	525	1,080	304	88	2,520	48	19	181
3	17	20	42	880	290	2,870	465	77	2,340	46	19	1,040
4	16	24	38	1,200	590	2,200	331	64	730	35	17	405
5	14	24	181	1,980	435	1,240	465	72	435	28	15	150
6	13	21	34	2,070	465	840	1,840	64	331	29	13	24
7	12	21	25	1,040	405	1,320	960	65	345	28	15	375
8	15	21	123	405	317	2,770	555	60	264	28	19	3,320
9	11	20	83	331	304	1,280	465	66	264	54	10	1,800
10	12	24	98	252	215	660	317	60	277	31	9	1,360
11	10	21	83	227	277	465	290	54	304	28	10	465
12	10	30	69	181	277	2,920	264	72	227	20	13	43
13	19	22	79	160	277	2,160	290	80	181	19	7	19
14	16	21	54	375	114	1,940	252	66	123	24	12	17
15	16	20	38	625	150	800	204	59	114	21	12	17
16	12	21	43	960	227	590	141	48	96	28	7	19
17	13	18	51	1,080	525	1,400	170	43	72	34	3.5	15
18	12	17	69	960	660	960	150	39	66	48	6	15
19	239	18	91	800	555	590	141	36	54	62	8	19
20	405	15	43	730	1,160	465	132	35	204	150	13	15
21	304	18	435	1,320	1,040	1,440	123	32	170	100	12	12
22	141	21	1,710	5,960	465	1,240	123	27	88	114	12	24
23	80	21	625	1,440	555	1,120	110	33	66	105	15	17
24	65	24	375	660	2,200	5,080	88	40	39	56	15	24
25	48	46	264	495	1,040	1,280	77	30	48	181	12	15
26	38	39	204	375	590	730	85	27	46	252	27	15
27	39	37	192	304	465	590	73	83	43	96	12	30
28	36	30	2,200	304	2,430	525	91	2,200	141	94	12	155
29	28	73	1,200	331	....	435	105	1,040	405	54	10	104
30	25	54	800	360	....	360	181	405	181	35	10	60
31	26	....	555	331	....	317	....	290	....	21	12	....

Monthly discharge of Blaine Creek at Yatesville, Ky., for the year ending Sept. 30, 1917.

[Drainage area, 216 square miles]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	405	10	56.0	0.259	0.30
November	73	15	26.1	.121	.14
December	2,200	25	319	1.48	1.71
January	5,960	160	858	3.97	4.58
February	2,430	114	620	2.87	2.99
March	5,080	317	1,370	6.34	7.31
April	1,840	73	302	1.40	1.56
May	2,200	27	176	.815	.94
June	2,520	39	358	1.66	1.85
July	252	19	65.5	.303	.35
August	27	3.5	12.7	.059	.07
September	3,320	12	333	1.54	1.72
The year	5,960	3.5	374	1.73	23.52

SCIOTO RIVER BASIN.

SCIOTO RIVER AT WAVERLY, OHIO.

LOCATION.—At Norfolk & Western Railway bridge about 1 mile southeast of Waverly, Pike County.

DRAINAGE AREA.—5,730 square miles (United States Engineer Corps).

RECORDS AVAILABLE.—March 23, 1916 to September 30, 1917.

GAGE.—Chain gage fastened to downstream side of bridge; read by W. G. Johnston. Sea-level elevation of zero of gage, 542.00 feet (United States Engineer Corps).

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge to which gage is attached, or from highway bridge 2,000 feet below gage.

CHANNEL AND CONTROL.—For stages over 12 feet the river spreads over the bottom lands, but all water passes under the bridge.

EXTREMES OF DISCHARGE.—Maximum stage during year, 16.27 feet March 15 (discharge 39,000 second-feet); minimum mean daily discharge, estimated to be about 350 second-feet in September.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined between 400 and 140,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage heights to rating table, except as noted. Records good.

COOPERATION.—Base data furnished by United States Engineer Corps.

The following discharge measurement was made by Crosley and Baker of the United States Army Engineer Corps:

October 18: Gage height, 1.46, discharge, 437 second-feet.

Daily discharge, in second-feet, of Scioto River at Waverly, Ohio, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	427	427	454	4,140	8,570	6,740	4,680	2,580	7,720	7,960	1,360	520
2	454	427	454	3,520	8,450	6,000	6,240	2,440	11,400	7,470	1,360	454
3	427	427	454	3,250	6,740	4,500	8,450	2,580	6,490	7,220	970	427
4	427	427	482	5,280	3,380	4,500	12,600	2,710	5,760	4,140	860	427
5	427	427	560	9,920	2,040	4,500	10,700	3,250	5,760	2,980	690	400
6	427	400	1,220	16,600	1,900	4,140	23,100	5,760	5,280	2,300	690	454
7	427	400	970	25,600	7,220	3,380	24,400	8,450	4,500	3,250	770	482
8	427	400	770	20,800	3,380	8,450	20,800	6,980	3,520	6,490	690	482
9	427	400	690	11,900	2,710	8,450	17,700	4,680	5,760	11,600	620	482
10	427	400	690	8,200	2,580	8,700	12,000	3,800	8,450	6,740	620	454
11	400	427	620	7,260	2,170	9,920	10,000	3,120	8,200	3,800	620	427
12	427	427	560	6,330	2,040	18,200	8,000	2,840	5,760	2,840	620	400
13	427	454	560	5,390	1,900	23,160	6,500	2,440	3,960	3,120	560	400
14	427	440	520	4,460	1,760	33,000	5,500	2,300	3,520	2,980	454	400
15	438	427	520	3,520	1,630	38,500	4,140	2,040	2,980	13,600	482	400
16	449	400	500	3,120	1,630	37,000	3,120	1,760	2,440	21,400	1,630	375
17	460	427	500	2,300	1,630	18,200	2,710	1,500	2,040	17,700	690	350
18	471	400	500	2,710	1,900	11,600	2,580	1,360	1,630	8,450	560	350
19	482	400	500	2,170	2,040	8,200	4,860	1,360	1,500	10,200	540	375
20	770	400	500	2,170	2,440	6,490	3,800	1,360	1,360	6,240	520	400
21	860	400	500	5,760	2,710	5,760	3,520	1,090	1,500	5,280	520	400
22	770	400	500	34,300	3,380	5,760	2,580	1,090	1,900	4,680	482	400
23	620	400	500	29,300	3,800	5,520	2,170	1,220	1,630	3,960	482	400
24	560	400	600	16,600	20,500	22,500	2,170	1,090	1,500	2,980	620	400
25	482	460	700	9,680	15,100	20,200	2,170	1,090	1,360	2,440	620	400
26	482	520	2,040	8,450	9,920	14,300	2,040	860	1,220	2,040	520	400
27	482	454	6,740	5,760	8,450	10,900	2,300	4,680	1,220	1,900	482	400
28	454	482	29,700	6,490	6,980	7,470	2,040	21,100	1,360	3,800	482	400
29	454	482	17,400	8,940	....	6,000	2,300	21,100	5,520	2,980	454	400
30	427	454	14,800	8,810	....	4,140	2,980	10,700	9,180	2,170	454	375
31	427	....	8,700	8,690	....	3,660	....	6,740	....	1,630	520	....

NOTE.—Daily discharge estimated or interpolated because of missing gage readings or ice effect from observer's notes, climatic records, and from records at other gaging stations as follows: Oct. 15-18; Nov. 9, 14, 23, 25; Jan. 11-14, 30-Feb. 1; Mar. 4; Apr. 10-14; Aug. 19; Sept. 17-30.

Monthly discharge of Scioto River at Waverly, Ohio, for the year ending Sept. 30, 1917.

[Drainage area, 5,730 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	860	400	486	0.085	0.10
November	520	400	426	.074	.08
December	29,700	454	3,040	.531	.61
January	34,300	2,170	9,400	1.64	1.89
February	20,500	1,630	4,890	.853	.89
March	38,500	3,380	11,900	2.08	2.40
April	24,400	2,040	7,200	1.26	1.41
May	21,100	860	4,320	.754	.87
June	11,400	1,220	4,150	.724	.81
July	21,400	1,630	5,950	1.04	1.20
August	1,630	454	676	.118	.14
September	....	....	414	.072	.08
The period	38,500	....	4,420	.771	10.48

LITTLE MIAMI RIVER BASIN.

LITTLE MIAMI RIVER AT MIAMIVILLE, OHIO.

Location.—At two-span steel highway bridge about one-third mile southeast of Miamiville, Clermont County.

Drainage area.—1,200 square miles.

Records available.—June 21, 1915, to September 30, 1917.

Gage.—Chain gage attached to downstream side of bridge; read by Arnold Barrere.

Discharge measurements.—Made from downstream side of bridge, except at low stages, when they are made by wading.

Channel and control.—Channel clean of vegetation, except at high stages. Control probably permanent.

Extremes of discharge.—Maximum stage recorded during year, 13.5 feet at 4 p. m. January 5 (discharge, 25,600 second-feet); minimum mean daily stage recorded, 1.36 feet, September 25 (discharge, 72 second-feet).

Regulation.—Low-water flow regulated to some extent by operation of flour mill at Fosters Crossing about 11 miles upstream.

Accuracy.—Stage-discharge relation permanent; may be affected by ice to some extent during December 13–25 and January 11–20. Rating curve well defined between 100 and 6,000 second-feet and fairly well above 6,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Low-stage record subject to error because of artificial regulation.

Cooperation.—Base data furnished by U. S. Army Engineers.

Daily discharge, in second-feet, of Little Miami River at Miamiville, Ohio, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	178	110	169	760	2,470	920	722	840	1,530	584	282	106
2	161	120	183	685	1,470	962	7,710	650	2,100	3,090	247	110
3	142	116	169	1,840	722	840	3,090	526	1,470	880	230	164
4	118	125	180	1,100	800	1,000	1,650	1,650	1,050	500	200	265
5	130	112	300	23,600	760	1,050	4,850	3,810	5,370	412	180	230
6	92	116	433	12,400	615	615	9,010	1,650	4,850	317	230	215
7	118	114	372	4,850	650	800	2,870	1,240	2,100	372	215	158
8	94	128	300	2,670	685	1,780	1,650	1,000	1,300	412	230	392
9	122	135	300	1,780	615	1,780	1,410	840	2,280	372	200	161
10	108	125	230	1,360	526	1,410	1,190	722	3,090	282	194	158
11	84	132	282	1,190	454	2,100	1,000	584	1,780	282	186	150
12	108	116	230	760	412	13,700	880	552	1,140	282	161	125
13	116	102	200	685	353	17,300	800	526	880	282	167	140
14	84	142	200	584	353	15,800	650	454	685	552	153	138
15	94	138	158	454	335	7,450	552	454	615	760	169	116
16	98	142	150	526	335	3,310	584	392	526	526	160	116
17	140	112	148	526	335	1,930	500	412	433	760	156	92
18	116	106	153	552	454	1,300	454	372	433	500	158	104
19	148	102	148	477	500	920	650	300	392	615	132	100
20	247	180	175	454	920	685	615	282	433	454	125	100
21	247	120	172	685	650	1,490	500	335	412	353	189	108
22	172	116	150	19,400	477	1,490	454	317	335	353	197	118
23	230	167	150	5,110	5,890	1,430	433	412	317	335	189	103
24	178	200	150	2,470	6,670	5,370	412	353	282	317	300	88
25	142	247	145	1,530	2,100	3,310	454	335	317	265	230	72
26	150	156	215	1,190	1,470	1,930	433	300	300	962	192	98
27	145	142	17,100	880	1,240	1,470	433	6,410	282	1,650	186	96
28	135	158	6,150	1,530	1,000	1,140	500	15,800	300	962	156	102
29	104	197	2,670	5,110	....	962	615	4,850	880	584	148	102
30	100	161	1,240	4,070	....	760	650	2,280	1,100	412	138	104
31	96	....	920	2,470	....	685	....	1,650	....	353	122	....

Monthly discharge of Little Miami River at Miamiville, Ohio, for the year ending Sept. 30, 1917.

[Drainage area, 1,200 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	247	84	135	0.112	0.13
November	247	102	138	.115	.13
December	17,100	145	1,080	.900	1.04
January	23,600	454	3,250	2.71	3.12
February	6,670	335	1,190	.992	1.03
March	17,300	615	3,090	2.58	2.97
April	9,010	412	1,520	1.27	1.42
May	15,800	282	1,620	1.35	1.56
June	5,370	282	1,230	1.02	1.14
July	3,090	265	606	.505	.58
August	300	122	187	.156	.18
September	392	72	138	.115	.13
The year	23,600	72	1,190	.992	13.43

EAST FORK OF LITTLE MIAMI RIVER AT PERINTOWN, OHIO.

Location.—At single-span steel highway bridge at Perintown, Clermont County, about 5 miles above junction of East Fork and Little Miami rivers.

Drainage area.—459 square miles.

Records available.—May 7, 1915, to September 30, 1917.

Gage.—Chain gage attached to downstream side of bridge; read by G. W. Taylor.

Discharge measurements.—Made from downstream side of bridge except at low stages when they are made by wading.

Channel and control.—Bed of river mostly rock; banks covered with trees and brush above a stage of about 5 feet; control rock and gravel; probably permanent.

Extremes of discharge.—Maximum stage recorded during year, 18.6 feet at noon December 27 (discharge, about 21,300 second-feet); minimum stage, −0.10 foot September 23 (discharge, about 9 second-feet).

Ice.—Stage-discharge relation affected by ice in severe winters.

Accuracy.—Stage-discharge relation permanent; may be affected by ice to some extent during parts of December, January, and February. Rating curve well defined between 10 and 7,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table.

Cooperation.—Base data furnished by United States Army Engineers.

Discharge measurements of East Fork of Little Miami River at Perintown, Ohio, during the year ending Sept. 30, 1917.

[Made by L. M. Crosley.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Jan. 5	14.08	12,900
5	12.15	9,400

Daily discharge, in second-feet, of East Fork of Little Miami River at Perintown, Ohio, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	11	13	65	220	627	775	375	110	246	44	39	25
2	12	13	49	246	246	825	6,940	95	1,500	142	35	24
3	12	12	44	1,900	151	725	1,640	82	925	82	23	41
4	11	11	43	1,840	110	1,260	627	110	337	75	18	24
5	11	11	1,020	15,100	110	627	2,460	356	2,180	62	16	17
6	10	11	627	6,680	117	413	4,760	274	1,260	48	18	16
7	10	11	208	1,500	117	775	1,260	172	453	37	33	38
8	10	11	125	627	125	2,460	725	117	246	74	21	304
9	18	11	88	394	110	1,640	394	102	2,600	375	17	195
10	18	11	75	304	110	1,020	413	82	3,290	133	18	63
11	13	11	69	220	110	627	320	75	775	88	16	27
12	12	12	58	172	102	1,640	233	69	337	59	13	18
13	11	12	48	142	73	6,080	195	67	208	39	13	14
14	10	12	34	125	65	6,810	151	62	151	31	15	12
15	10	11	31	102	68	1,500	133	56	133	28	13	11
16	10	11	33	102	71	675	117	48	102	24	12	10
17	10	11	33	117	75	582	102	39	82	246	12	10
18	10	11	31	117	95	453	95	35	74	675	12	10
19	27	11	26	117	110	260	88	34	68	495	11	10
20	151	13	24	125	133	220	82	32	64	337	11	10
21	220	13	23	1,380	125	582	75	30	60	172	11	11
22	125	12	38	10,900	142	675	71	35	51	142	11	11
23	95	49	50	1,640	1,900	2,180	67	55	44	117	10	9
24	60	246	60	582	3,460	6,080	60	33	38	102	10	11
25	40	110	88	394	825	1,900	56	28	35	117	10	12
26	27	95	337	274	453	675	54	25	31	1,080	9.3	12
27	23	60	19,100	220	394	495	68	1,500	32	627	9.5	12
28	20	39	8,350	675	516	474	102	3,800	39	289	9.5	12
29	17	56	1,200	5,080	....	304	125	1,500	95	151	10	12
30	15	95	495	2,600	....	220	133	538	75	95	13	13
31	14	....	246	925	....	172	....	289	....	60	27	....

Monthly discharge of East Fork of Little Miami River at Perintown, Ohio, for the year ending Sept. 30, 1917.

[Drainage area, 459 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	220	10	33.6	0.073	0.08
November	246	11	33.5	.073	.08
December	19,100	23	1,060	2.31	2.66
January	15,100	102	1,770	3.86	4.45
February	3,460	65	376	.819	.85
March	6,810	172	1,390	3.03	3.49
April	6,940	54	731	1.59	1.77
May	3,800	25	318	.693	.80
June	3,290	31	518	1.13	1.26
July	1,080	24	195	.425	.49
August	39	9.3	16.0	.035	.04
September	304	9	33.1	.072	.08
The year	19,100	9	543	1.18	16.05

LICKING RIVER BASIN.

LICKING RIVER AT FARMERS, KY.

LOCATION.—About 100 feet below Chesapeake & Ohio Railway bridge and about 300 feet below two-span steel highway bridge, three-fourths of a mile west of Farmers, Rowan County.

DRAINAGE AREA.—768 square miles (measured by United States Engineer Corps).

RECORDS AVAILABLE.—July 20, 1915, to September 30, 1917.

GAGE.—Combination vertical staff and slope gage on east bank of river; read by T. E. Craig.

DISCHARGE MEASUREMENTS.—Made from downstream side of two-span highway bridge 300 feet above gage.

CHANNEL AND CONTROL.—Bed of stream solid rock, straight above and below gage. Control is a rock reef about 1 mile below gage.

EXTREMES OF STAGE.—Maximum stage recorded during year 25.6 feet at 7 a. m. January 22; minimum stage 1.1 feet August 17 and 18.

ICE.—No information.

REGULATION.—The flow at low stages may be affected by storage of water for use of a sawmill at a movable dam a short distance above the gage. Dam is submerged at gage height 5 feet.

ACCURACY.—Stage-discharge relation probably permanent; not affected by ice during the year. On August 4, 1917, the sloping gage was found to be in error as follows: 5-foot mark at elevation 5.04 feet; 4-foot mark at elevation 4.17 feet; and 2-foot mark at elevation 2.23 feet. In the absence of definite information as to date of change in gage, it was assumed that the change occurred March 1, 1916, and remained constant until August 4, 1917, when discovered. Gage readings during this period below 5.0 feet were increased as indicated by the determined errors in the gage. Rating curve not yet determined. Gage read to half-tenths twice daily. Gage readings less than 5 feet are questionable on account of error in gage.

COOPERATION.—Records furnished by United States Engineer Corps.

Daily gage height, in feet, of Licking River at Farmers, Ky., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.75	2.09	2.45	4.76	5.45	19.00	4.49	3.28	5.50	2.47	1.83	1.42
2	2.12	2.02	2.41	4.34	6.50	17.60	5.28	3.90	10.80	2.25	1.77	1.18
3	2.02	1.99	2.38	5.78	6.10	16.55	6.82	2.99	13.85	2.15	1.77	1.38
4	1.92	1.98	2.35	10.82	4.70	18.82	5.92	2.84	10.52	1.96	1.75	1.20
5	1.94	1.96	5.25	15.75	3.83	18.12	5.70	2.77	6.95	1.85	1.58	1.20
6	1.80	1.89	4.03	18.45	3.72	14.55	14.60	2.70	5.05	1.77	1.48	1.32
7	1.70	1.89	3.40	17.10	3.67	10.90	14.15	2.62	5.60	1.75	1.38	1.45
8	1.73	4.15	3.28	11.05	4.01	16.20	10.28	2.60	5.08	1.77	1.38	3.92
9	1.70	1.83	3.03	5.95	4.30	17.98	6.65	2.54	4.68	1.73	1.52	5.78
10	1.67	1.92	2.89	4.95	4.28	15.10	5.60	2.60	5.60	1.70	1.38	3.90
11	1.65	1.87	2.74	4.60	3.81	10.45	4.90	2.64	4.49	1.75	1.30	2.60
12	1.87	1.92	2.67	4.12	3.51	16.82	4.49	2.72	4.15	1.89	1.28	1.98
13	1.83	2.08	2.57	3.79	3.81	17.25	4.34	2.72	3.67	1.83	1.35	1.68
14	1.77	2.09	2.47	3.77	3.30	16.95	4.47	2.62	3.35	1.85	1.32	1.55
15	1.80	2.02	2.28	3.86	3.77	12.72	4.17	2.54	3.25	1.92	1.35	1.42
16	1.77	1.99	2.50	3.93	4.93	9.00	3.67	2.47	3.12	1.87	1.18	1.32
17	1.73	1.96	2.31	4.84	7.88	9.80	3.61	2.38	2.93	2.21	1.12	1.60
18	1.75	1.89	2.54	4.24	8.10	11.38	3.38	2.52	2.72	2.12	1.12	1.52
19	2.21	1.87	2.52	4.62	6.78	9.78	3.49	2.23	2.54	2.47	1.35	1.45
20	5.05	1.89	2.28	3.96	6.70	6.78	3.18	2.21	7.95	2.80	1.25	1.42
21	5.55	1.87	2.70	7.98	9.70	11.05	2.99	2.60	4.06	2.72	1.32	1.38
22	4.27	1.87	7.82	24.90	8.98	12.05	2.93	2.04	3.01	2.80	1.45	1.40
23	3.40	1.94	9.85	22.92	6.68	9.42	2.91	2.45	2.70	2.50	1.58	1.45
24	3.01	2.60	6.62	20.18	10.00	18.98	2.80	2.64	2.54	2.43	1.48	1.65
25	2.74	2.72	4.84	12.00	12.55	18.62	2.70	2.52	2.45	3.01	1.40	1.78
26	2.54	2.62	4.26	5.98	13.00	15.25	2.67	2.21	2.21	4.78	1.20	1.80
27	2.50	2.45	4.68	5.10	7.62	8.42	2.62	10.40	2.06	4.06	1.35	1.50
28	2.38	2.38	12.52	4.72	12.30	6.78	2.54	18.38	4.44	2.38	1.42	1.88
29	2.26	2.33	14.95	4.78	....	6.02	2.77	20.75	3.03	2.31	1.40	3.22
30	2.18	2.47	11.72	4.98	....	5.32	3.49	16.92	2.72	1.94	1.48	....
31	1.92	....	7.32	4.92	....	4.82	....	7.55	....	1.89	1.50	....

NOTE.—No gage height furnished for Sept. 30.

LICKING RIVER AT CATAWBA, KY.

LOCATION.—About 200 feet below Catawba ford, about one-fourth mile north of Catawba, Pendleton County. Kinkaid Creek enters from right about 1,000 feet below gage.

DRAINAGE AREA.—3,300 square miles.

RECORDS AVAILABLE.—July 14, 1916, to September 30, 1917.

GAGE.—Combination slope and vertical staff on south bank of river about 200 feet below the ford; read by G. A. Frank. Elevation of zero of gage is 498.37 feet above sea level, which corresponds approximately to 69 feet on the United States Weather Bureau gage on Ohio River at Cincinnati, Ohio.

DISCHARGE MEASUREMENTS.—Made from cable about 500 feet upstream from gage.

CHANNEL AND CONTROL.—Bed of river at cable is mostly ledge rock. The banks are heavily wooded above an elevation of about 7 feet on the gage. The control is a rock bar just below the mouth of Kinkaid Creek; probably permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period of records, 32.8 feet at 6 a. m. January 23, 1917 (discharge, 55,200 second-feet); minimum stage recorded, 0.80 foot September 28, 1917 (discharge, 89 second-feet).

ICE.—Stage-discharge relation affected by ice during severe winters.

ACCURACY.—Stage-discharge relation probably permanent; not affected by ice during year. Rating curve fairly well defined between 110 and 860 second-feet; and well defined above 860 second-feet; below 110 second-feet the curve is an extension. Gage read twice daily to hundredths. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent.

COOPERATION.—Base data furnished by United States Army Engineers.

Discharge measurements of Licking River at Catawba, Ky., during the year ending Sept. 30, 1917.

[Made by L. M. Crosley.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Oct. 3	1.26	146	Jan. 10	9.07	8,250	Jan. 24	25.45	38,900
24	3.81	1,520	10	8.48	7,370	25	21.20	29,000
24	3.68	1,460	22	31.95	51,200	25	20.65	29,800
25	3.29	1,080	22	31.95	53,200	26	19.00	27,200
Jan. 8	13.55	15,900	23	32.45	54,800	26	18.08	25,000
9	12.25	13,400	24	27.4	42,100	27	14.55	18,200
9	11.85	12,600	24	26.3	39,300			

Daily discharge, in second-feet, of Licking River at Catawba, Ky., for the year ending Sept. 30, 1916.

Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.
1		132	210	11		1,360	342	21	2,370	980	125
2		132	1,830	12		1,270	324	22	1,830	939	125
3		125	1,730	13		900	139	23	1,830	939	125
4		125	2,840	14	125	900	139	24	1,730	900	118
5		118	1,360	15	125	1,020	132	25	939	900	118
6		562	900	16	125	3,440	125	26	647	900	118
7		380	2,370	17	125	5,510	125	27	360	589	112
8		360	900	18	125	6,940	125	28	342	360	112
9		589	1,830	19	200	5,510	132	29	342	342	118
10		2,480	589	20	939	2,370	132	30	139	324	125
								31	132	324	

Daily discharge, in second-feet, of Licking River at Catawba, Ky., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	118	291	399	9,130	5,090	11,100	1,830	1,100	18,800	1,360	342	189
2	118	234	360	4,570	5,370	19,900	29,700	1,540	13,400	1,540	261	154
3	118	210	360	17,500	5,650	19,500	20,300	1,270	10,600	1,180	234	154
4	125	189	360	18,200	4,570	21,800	12,900	1,100	10,400	618	210	132
5	125	189	442	19,700	3,570	25,300	14,400	1,020	9,930	464	170	112
6	125	189	2,840	21,600	2,370	20,800	27,700	860	7,080	399	170	112
7	125	180	4,570	19,500	2,150	18,400	20,300	782	4,830	342	154	112
8	118	170	2,260	16,400	2,370	21,400	16,700	711	6,790	308	139	13,000
9	118	162	1,540	13,000	2,370	30,900	13,000	647	12,000	261	139	10,900
10	118	170	1,180	8,240	2,260	30,100	8,830	589	8,980	234	132	5,650
11	112	154	900	4,830	1,930	24,900	6,210	589	6,790	210	125	3,320
12	112	154	860	3,570	1,440	32,100	4,700	589	5,090	200	112	1,830
13	112	154	647	2,840	1,360	40,500	3,820	618	3,570	170	112	1,100
14	112	170	589	2,150	1,540	41,100	3,320	647	3,440	170	139	711
15	106	189	589	1,730	1,540	32,300	3,080	647	2,260	589	146	487
16	112	189	1,020	2,370	1,360	20,800	2,840	589	2,150	2,720	146	399
17	112	189	1,360	3,820	1,830	14,100	2,370	536	1,730	980	139	324
18	112	189	536	2,600	5,650	10,200	1,930	487	1,360	442	125	276
19	112	189	512	2,370	8,630	11,100	1,730	442	1,100	291	112	222
20	324	180	589	2,720	8,240	9,290	1,540	399	1,020	248	106	200
21	1,730	170	512	11,700	7,220	18,000	1,360	360	3,440	782	106	189
22	2,840	162	1,360	53,400	6,790	21,000	1,270	324	4,570	2,150	118	210
23	2,260	189	5,930	54,700	11,100	16,500	1,100	324	1,930	1,730	125	360
24	1,360	512	6,790	43,400	13.900	23,500	1,020	291	1,180	1,440	125	234
25	900	360	7,370	30,500	11,400	21,600	939	291	900	1,440	100	189
26	589	291	6,790	25,300	9,610	18,800	860	360	647	1,020	100	170
27	360	342	36,700	15,100	10,200	17,800	821	40,700	536	647	100	154
28	360	512	26,900	6,210	9,130	13,000	711	46,800	487	1,180	89	154
29	399	487	21,000	7,650	....	8,240	782	31,700	1,540	821	100	189
30	420	464	15,800	6,360	....	5,930	821	20,100	2,600	536	154	170
31	324	....	12,000	5,230	....	4,570	....	17,500	....	399	162	....

Monthly discharge of Licking River at Catawba, Ky., for the years ending Sept. 30, 1916–17.

[Drainage area, 3,300 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1916.					
July 14–31	2,370	125	690	0.209	0.14
August	6,940	118	1,350	.409	.47
September	2,840	112	582	.176	.20
1916–1917.					
October	2,840	106	454	.138	.16
November	512	154	241	.073	.08
December	36,700	360	5,260	1.59	1.83
January	54,700	1,730	14,100	4.27	4.92
February	13,900	1,360	5,310	1.61	1.68
March	41,100	4,570	20,100	6.09	7.02
April	29,700	711	6,900	2.09	2.33
May	46,800	291	5,610	1.70	1.96
June	18,800	487	4,970	1.51	1.68
July	2,720	170	802	.243	.28
August	342	89	145	.044	.05
September	13,000	112	1,380	.418	.47
The year	54,700	89	5,460	1.65	22.46

SOUTH FORK OF LICKING RIVER AT HAYES, KY.

Location.—At two-span steel highway bridge at Hayes, Pendleton County, about 2½ miles south of Falmouth.

Drainage area.—922 square miles (measured by United States Engineer Corps).

Records available.—July 7, 1916, to September 30, 1917.

Gage.—Chain gage attached to downstream handrail of bridge; read by J. K. Frazer. Sea-level elevation of zero of gage, 540.10 feet.

Discharge measurements.—Made from upstream side of bridge.

Channel and control.—Bed of river composed of ledge rock; banks lined with vegetation. Control about 800 feet below gage; probably permanent. Backwater begins to affect the stage-discharge relation at this station when the main Licking River reaches a stage of about 28 feet on the gage at Falmouth.

Extremes of stage.—Maximum stage recorded during year, 15.5 feet at 7 a. m. January 22; minimum stage recorded, 0.20 foot at 6 a. m. September 6.

Ice.—Stage-discharge relation not affected by ice except during severe winters.

Accuracy.—Stage-discharge relation probably permanent, except as affected by backwater from the Licking. Not affected by ice during the year. Rating curve not yet determined. Gage read twice daily to hundredths.

Cooperation.—Base data furnished by United States Engineer Corps.

Discharge measurements of South Fork of Licking River at Hayes, Ky., during the year ending Sept. 30, 1917.

[Made by L. M. Crosley.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Oct. 3	.63	17.4	Jan. 22	14.0	23,400	Jan. 24	9.55	13,000
Jan. 9	3.66	1,730	23	14.20	22,900	25	4.67	3,300
10	3.17	1,240						

Daily gage height, in feet, of South Fork of Licking River at Hayes, Ky., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	0.65	0.79	0.72	3.05	2.89	3.46	2.89	1.70	4.81	1.07	0.85	0.67
2	.59	.68	.69	2.73	3.20	5.68	11.17	1.57	4.41	2.35	.74	.56
3	.62	.61	.66	7.95	3.28	4.96	7.99	1.48	4.06	1.81	.69	.46
4	.56	.53	.69	6.48	2.42	6.36	5.29	1.35	3.78	1.28	.66	.39
5	.52	.52	1.15	7.18	3.26	6.66	5.77	1.41	3.13	1.08	.60	.33
6	.60	.51	1.08	6.92	3.70	5.13	8.42	1.35	2.61	1.00	.57	.24
7	.53	.53	2.34	5.72	3.83	4.63	6.49	1.35	2.33	.94	.54	.25
8	.57	.56	1.99	4.32	3.33	6.39	4.79	1.31	3.96	.88	.53	2.72
9	.60	.59	1.72	3.51	2.94	9.09	4.27	1.22	6.24	.83	.52	4.72
10	.60	.57	1.48	3.11	2.67	8.02	3.77	1.17	4.48	.79	.53	3.34
11	.64	.56	1.37	2.81	2.57	6.39	3.31	1.17	3.94	.75	.52	2.08
12	.53	.57	1.28	2.53	2.43	10.82	3.02	1.17	3.12	.70	.52	1.51
13	.45	.57	1.13	2.29	2.17	11.19	2.74	1.25	2.62	.66	.51	1.26
14	.43	.58	1.07	2.12	2.20	8.47	2.60	1.32	3.17	.66	.45	1.07
15	.40	.57	1.14	1.84	2.05	6.87	2.38	1.20	2.36	.76	.52	.99
16	.38	.55	1.06	1.88	1.89	5.02	2.30	1.17	2.51	1.61	.65	.93
17	.35	.55	1.15	2.33	1.93	4.25	2.15	1.05	2.17	1.10	.53	.89
18	.31	.52	1.10	2.35	2.72	3.82	2.04	1.07	1.93	.88	.43	.74
19	.71	.54	1.06	2.31	4.06	3.77	1.93	1.03	1.67	.78	.42	.61
20	.87	.52	1.07	2.16	3.66	3.22	1.81	.97	1.60	.72	.37	.50
21	1.31	.53	1.18	5.85	3.46	6.87	1.72	.89	1.51	.67	.31	.86
22	1.26	.56	1.82	14.68	3.12	7.39	1.65	.92	1.51	.75	.41	.48
23	1.06	.71	1.60	14.08	4.83	5.22	1.56	.88	1.98	1.45	.53	.58
24	1.08	1.45	2.49	8.73	4.16	6.97	1.50	.86	1.63	1.28	.49	.70
25	1.19	1.23	3.72	4.43	3.96	6.65	1.44	.91	1.46	1.72	.41	.65
26	1.10	.94	3.52	3.68	3.46	4.62	1.46	1.00	1.19	1.74	.33	.54
27	1.00	.85	11.82	3.24	3.42	4.77	1.37	13.36	1.11	1.31	.28	.47
28	.95	.76	8.40	3.26	3.00	3.67	1.27	13.66	1.04	1.29	.30	.42
29	.88	.77	7.08	4.76	......	3.41	1.42	7.58	1.08	1.17	.36	.39
30	.91	.73	4.92	3.41	......	2.96	1.54	4.76	1.09	1.05	.39	.44
31	.89	......	3.65	3.11	......	2.67	......	3.46	......	.96	1.00	......

MIAMI RIVER BASIN.

MIAMI RIVER AT SIDNEY, OHIO.

Location.—At North Street Bridge, Sidney, Shelby County, Ohio.

Drainage area.—555 square miles.

Records available.—February 1, 1914, to September 30, 1917.

Gage.—Vertical staff attached to downstream side of west abutment; read by H. B. Blake. Elevation of zero of gage, 926.46 feet above mean sea level.

Discharge measurements.—Made from downstream side of the bridge at the gage, from the upstream side of highway bridge about 1,000 feet below the gage, or by wading.

Channel and control.—Shift during floods. Foliage along the banks may cause some backwater at high stages.

Extremes of stage.—The flood of March–April, 1913—the highest known to have occurred at this station—reached a stage March 25 represented by 17.9 feet on gage.

Ice.—Stage-discharge relation may be affected by ice during short periods.

Regulation.—A small power plant a short distance above the gage draws water from the Miami & Erie Canal feeder (see "Diversions"), and discharges it into the river above the gage. Another power plant takes water from Tawawa Creek and discharges it into the river above the point of control, which is just below the gage; this power plant is not in operation during the greater part of the summer for lack of water. The flow is practically unregulated by these power plants.

Diversions.—Water to feed the Miami & Erie Canal is diverted from the river at Port Jefferson, but a part of it is returned to the river above the gage. The amount diverted past the gage may be a large proportion of the low-water flow at the gage. Water diverted is not included in the table of daily discharge.

Accuracy.—Stage-discharge relation practically permanent; not seriously affected by ice during the year. Measurements in 1917 indicate a shift in stage-discharge relation and do not cover sufficient range in stage to define a rating curve. Gage read once daily to tenths.

Cooperation.—Gage-height record furnished by the United States Weather Bureau and results of discharge measurements by the Miami Conservancy District.

Discharge measurements of Miami River at Sidney, Ohio, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 26	H. R. Daubenspeck..	−0.90	42.0	June 4	H. R. Daubenspeck..	−0.02	151
Mar. 8	G. N. Burrell........	1.25	536	4	.....do..................	−.02	147
May 15	H. R. Daubenspeck..	−.15	141	Aug. 16	G. N. Burrell........	−.95	43.8

Discharge measurements of Miami & Erie Canal feeder at Sidney, Ohio, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 26	H. R. Daubenspeck..	....	[a] 19.0	May 15	H. R. Daubenspeck..	....	28.9
Mar. 8	G. N. Burrell........	....	17.2	Aug. 16	G. N. Burrell........	....	22.5

[a] Downstream side of Court Street bridge.

Daily gage height, in feet, of Miami River at Sidney, Ohio, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	0.2	−1.0	−0.9	−0.3	1.9	0.8	0.3	0.8	1.4	1.3	0.3	−0.9
2	.0	−1.1	− .9	− .4	1.5	.5	1.4	1.5	.8	.9	.0	−1.2
3	.0	−1.1	−1.0	− .4	1.2	.3	2.5	.9	− .1	1.0	− .2	−1.1
4	.0	−1.1	− .8	− .5	1.2	.1	2.5	.6	.0	.5	− .8	−1.2
5	.0	−1.1	− .7	1.8	2.1	.0	2.6	1.9	.0	.2	−1.0	−1.0
6	.1	−1.0	− .1	3.8	1.4	− .2	2.6	2.1	.8	− .3	−1.0	− .0
7	.0	−1.0	.5	3.2	1.2	− .2	2.5	1.5	1.6	− .6	− .9	− .8
8	.1	−1.1	.6	2.2	1.0	1.0	1.6	1.2	1.2	− .4	−1.0	− .8
9	.1	−1.1	.6	1.6	1.0	1.3	1.1	1.1	.8	.1	− .9	.9
10	.1	−1.0	.4	1.7	.8	1.2	.8	.8	.8	.1	− .9	−1.0
11	.0	−1.0	.4	1.3	.8	1.8	.7	.3	1.0	.1	−1.0	−1.2
12	.0	−1.1	.4	1.0	.8	3.2	.6	.2	.9	− .4	− .9	−1.1
13	− .6	−1.1	.2	.8	.7	3.0	.4	.0	.9	.0	−1.0	−1.0
14	− .7	−1.0	.2	.7	.7	6.1	.2	− .1	.9	6.5	−1.0	−1.0
15	− .7	−1.1	.0	.6	.7	4.7	.2	− .2	.6	4.8	− .9	−1.2
16	− .7	−1.1	− .2	.4	.5	3.2	.1	− .3	.0	3.6	− .9	−1.3
17	−1.0	−1.1	− .4	.3	.0	2.2	− .1	− .4	.1	3.7	−1.0	−1.4
18	−1.1	−1.0	− .6	.3	− .3	1.8	.0	− .5	.1	2.2	−1.0	−1.5
19	−1.1	−1.1	− .8	.3	− .3	1.2	.1	− .5	.0	2.0	−1.1	−1.5
20	−1.0	−1.1	− .7	.3	2.0	1.0	.1	− .6	.3	.9	−1.0	−1.4
21	− .7	−1.1	− .7	.3	1.7	1.5	− .1	− .4	− .2	.6	− .9	−1.3
22	− .8	−1.0	− .7	1.5	1.4	1.7	− .2	− .4	− .2	.3	− .8	−1.2
23	− .9	− .9	− .8	2.8	1.5	1.3	− .3	.9	− .3	.0	− .9	−1.2
24	−1.0	− .6	− .9	2.0	2.8	2.7	− .3	.5	1.6	− .2	− .9	−1.2
25	−1.0	− .7	− .9	1.6	1.9	2.5	− .1	− .1	1.0	− .4	− .9	−1.1
26	− .9	− .9	− .8	1.3	1.2	1.6	− .1	− .2	.5	1.4	− .9	−1.0
27	−1.0	− .9	− .6	1.1	1.4	1.2	.1	1.2	.9	1.0	−1.0	−1.0
28	− .9	− .9	1.4	.8	1.2	1.0	− .1	1.1	.8	.9	−1.0	−1.0
29	−1.0	− .8	1.0	.6	....	.7	− .2	1.6	3.9	.6	−1.0	−1.0
30	−1.1	− .9	.7	1.7	....	.4	− .2	.6	2.6	.7	−1.0	−1.0
31	−1.1	....	.1	1.4	....	.2	....	.8	....	.6	− .9	....

MIAMI RIVER AT PIQUA, OHIO.

Location.—At North Main Street Bridge at Piqua, Miami County.

Drainage area.—842 square miles (determined by Morgan Engineering Co.).

Records available.—October 1, 1913, to June 30, 1914; October 1, 1914, to September 30, 1917. The United States Weather Bureau has obtained daily gage readings since January 1, 1911, and flood stages January 1, 1907, to December 31, 1910.

Gage.—Mott gage; read by V. D. Crist. Sea-level elevation of zero of gage, 849 feet.

Discharge measurements.—Made from upstream side of highway bridge about 3,000 feet below gage, or by wading.

Channel and control.—Control shifts somewhat during floods.

Extremes of stage.—Flood of March-April, 1913, highest known at station, reached stage of 23.3 feet March 25, referred to gage datum.

Ice.—Stage-discharge relation affected by ice during winters.

Diversions.—Water from Miami & Erie Canal feeder is taken from the feeder in hydraulic canal and carried through a siphon under Loramie Creek, thence along the edge of the hills to Piqua, where it is used for power. It is discharged into the canal about a mile below the gage. In addition, water is diverted from the river into the lower canal level about 3 miles above the gage. The total diversion is therefore the flow in the "hydraulic" plus the flow in the canal opposite the gage. There has been practically no flow in the canal since the banks were washed out February 1, 1916.

Regulation.—Water is discharged from power plants into the river above the gage, but the effect of the regulation is not appreciable.

ACCURACY.—Stage-discharge relation considered permanent during 1916 and 1917; probably affected by ice during parts of December, January, and February of these two years, although none was reported. Rating curve fairly well defined between 20 and 20,000 second-feet, beyond these limits the curve is an extension. Gage read daily to tenths. Gage-height record previous to October 1, 1914, unreliable. Records October 1, 1915, to September 30, 1917, considered good, except for parts of the winter months when affected by ice.

COOPERATION.—Gage-height record furnished by the United States Weather Bureau. Results of discharge measurements furnished by the Miami Conservancy District.

Discharge measurements of Miami River at Piqua, Ohio, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	Sec.-ft.			Feet.	Sec.-ft.
Oct. 27	H. R. Daubenspeck	0.90	71.4	June 30	H. R. Daubenspeck	3.68	3,080
Mar. 9	G. N. Burrell	2.12	916	July 26	B. E. Jones	2.08	788
May 16	H. R. Daubenspeck	1.21	185	July 27	G. N. Burrell	1.76	554

Discharge measurements of hydraulic canal at Piqua Ohio, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	Sec.-ft.			Feet.	Sec.-ft.
Oct. 26	H. R. Daubenspeck	....	[a] 26.9	May 16	H. R. Daubenspeck	....	[a] 26.8
Mar. 9	G. N. Burrell	....	[a] 38.6	Aug. 16	G. N. Burrell	....	[b] 2.9

[a] At Pioneer Pole & Shaft Co., South Main Street. [b] Upstream side of Wood Street Bridge.

Daily discharge, in second-feet, of Miami River at Piqua, Ohio, for the years ending Sept. 30, 1916-17.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915-16.												
1	866	153	196	3,800	13,300	300	2,230	866	460	118	68	153
2	1,090	118	153	20,000	6,440	244	1,580	556	370	118	68	118
3	760	118	153	13,000	3,800	196	976	556	370	118	68	118
4	658	90	153	7,620	2,390	196	1,090	1,450	300	90	68	90
5	658	90	153	4,900	1,830	556	976	976	300	90	51	90
6	556	90	153	3,800	1,580	460	760	760	556	90	51	2,390
7	556	90	244	2,940	1,330	3,140	658	22,100	976	90	68	244
8	460	90	196	2,230	1,090	3,800	556	9,060	1,700	90	90	153
9	460	90	153	1,830	1,200	2,940	658	4,460	1,450	90	90	118
10	370	90	118	1,450	866	2,090	976	2,570	1,090	90	90	118
11	370	90	90	1,580	556	1,580	1,330	1,960	866	90	90	118
12	300	90	90	3,140	460	1,200	1,090	1,330	760	90	68	90
13	244	90	90	9,300	866	866	976	866	658	90	68	90
14	300	68	90	6,220	658	760	866	760	460	68	51	90
15	1,090	68	90	2,750	460	658	760	556	370	68	51	118
16	866	68	90	1,960	658	556	658	556	370	68	51	118
17	658	68	153	1,450	866	556	556	370	460	68	51	153
18	1,830	68	2,570	1,090	976	556	370	370	760	68	51	153
19	2,570	1,580	1,960	760	976	460	300	300	976	68	51	153
20	1,830	2,230	1,580	760	976	460	244	244	658	68	51	153
21	1,330	1,830	1,200	976	866	460	2,230	244	658	68	51	153
22	976	1,450	760	3,800	658	6,660	1,700	300	2,230	90	51	153
23	760	1,200	658	2,750	866	8,100	1,330	460	1,700	90	51	153
24	658	976	460	2,090	1,090	5,340	976	370	1,090	90	51	196
25	556	866	1,700	1,700	1,330	3,360	658	300	760	90	39	196
26	556	760	2,230	1,330	1,090	2,750	658	244	460	90	39	153
27	460	658	1,960	1,330	866	12,200	2,090	244	300	90	39	153
28	370	460	1,580	2,090	658	10,300	2,090	300	244	68	153	244
29	300	300	1,960	2,570	460	5,780	1,830	976	196	68	153	370
30	244	244	2,230	7,140	....	3,800	1,330	760	153	68	153	244
31	196	....	2,230	17,000	....	2,940	....	556	....	68	153	....

Daily discharge in second-feet, of Miama River at Piqua, Ohio, for the years ending Sept. 30, 1916–17—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1916–17.												
1	196	51	68	300	2,090	760	244	1,450	658	1,700	153	68
2	196	51	68	244	1,700	556	1,200	1,330	460	1,090	118	51
3	153	51	68	196	1,330	370	2,390	866	300	658	90	51
4	153	51	68	196	976	244	1,960	556	196	244	90	51
5	153	51	90	1,450	760	196	1,580	2,390	153	153	90	51
6	153	51	153	5,120	658	196	2,570	2,570	244	118	68	51
7	118	51	300	3,360	556	244	1,960	1,700	1,090	118	68	68
8	118	51	300	2,230	460	658	1,450	1,200	760	658	68	68
9	118	51	300	1,580	460	866	976	760	370	370	68	68
10	118	68	300	1,330	370	760	658	400	658	244	68	68
11	90	68	300	1,090	370	976	460	300	658	153	68	68
12	90	68	300	866	370	3,580	370	244	460	118	68	68
13	90	68	300	556	370	2,750	300	196	300	118	68	68
14	90	90	244	370	370	9,060	244	153	300	11,400	68	51
15	68	90	244	300	370	5,560	244	153	244	7,380	68	51
16	68	90	196	244	370	3,140	196	118	244	5,340	68	51
17	68	90	153	244	370	1,960	196	118	244	3,580	68	51
18	68	68	152	244	370	1,330	300	118	196	1,960	68	51
19	68	68	153	244	370	866	300	118	196	1,450	68	51
20	90	68	153	244	658	556	244	90	196	1,090	68	51
21	153	68	153	244	760	976	244	196	153	760	68	51
22	118	68	153	556	556	1,090	196	556	153	460	68	68
23	90	68	153	1,700	658	760	153	1,090	244	300	90	51
24	68	90	153	1,450	3,140	2,570	196	658	1,700	244	118	51
25	68	90	153	976	1,830	2,230	244	370	976	244	90	51
26	68	68	153	556	1,580	1,830	556	196	556	556	68	51
27	51	68	153	370	1,330	1,330	370	300	244	460	68	51
28	51	68	1,330	300	976	866	300	658	658	370	68	68
29	39	68	866	300	......	556	244	1,200	5,560	300	68	51
30	39	68	556	1,580	......	370	196	760	3,140	244	68	51
31	39	......	460	1,700	......	244	......	460	......	244	68	......

Monthly discharge of Miami River at Piqua, Ohio, for years ending Sept. 30, 1916–17.

Month.	Discharge in second-feet.			Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.		Maximum.	Minimum.	Mean.
1915–16.				1916–17.			
October	2,570	196	739	October	196	39	98.4
November	2,230	68	473	November	90	51	67.3
December	2,570	90	821	December	1,330	68	264
January	20,000	760	4,300	January	5,120	196	972
February	13,300	460	1,700	February	3,140	370	864
March	12,200	196	2,690	March	9,060	196	1,530
April	2,230	244	1,080	April	2,570	153	685
May	23,100	244	1,790	May	2,570	90	688
June	2,230	153	723	June	5,560	153	710
July	118	68	84.2	July	11,400	118	1,360
August	153	39	71.9	August	153	68	77.5
September	2,390	90	228	September	68	51	56.7
The year.	22,100	39	1,230	The year.	11,400	39	615

MIAMI RIVER AT TADMOR, OHIO.

Location.—At National Road bridge at Tadmor, Montgomery County, about 4½ miles below mouth of Honey Creek, which enters from left.

Drainage area.—1,130 square miles (determined by Morgan Engineering Co.).

Records available.—January 1, 1914, to September 30, 1917.

Gage.—Vertical staff in two sections; read by E. J. Shepard. Sea-level elevation of zero of gage, 763.68 feet.

Discharge measurements.—Made from upstream side of bridge at gage or by wading.

CHANNEL AND CONTROL.—May shift slightly during floods.

EXTREMES OF STAGE.—Highest stage known, 25.4 feet, occurred March 25, 1913.

ICE.—Stage-discharge relation may be affected by ice for short periods during severe winters.

DIVERSIONS.—None. All the water diverted into Miami & Erie Canal is wasted into the river several miles above Tadmor.

ACCURACY.—Stage-discharge relation practically permanent; probably affected by ice to some extent during December 14–27, January 14–27, and February 2–19. Rating curve well defined between 99 and 11,000 second-feet and extended beyond these limits. Gage read daily to tenths. Low-water readings are liable to be in error as they do not check closely with hydrographer's readings. Daily discharge ascertained by applying daily gage height to rating table.

The daily discharge as computed by the Miami Conservancy District is published. During rises additional gage readings are made and are used in determining the daily discharge instead of using the regular gage reading alone. In the table of monthly discharge, the maximum daily discharge for many months is the discharge corresponding to a special gage reading and not to the gage reading taken at the regular time. Records good except for periods of very low water or as affected by ice.

COOPERATION.—Gage-height record furnished by the United States Weather Bureau. Results of discharge measurements and daily discharge furnished by the Miami Conservancy District.

Discharge measurements of Miami River at Tadmor, Ohio, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 1	H. R. Daubenspeck..	1.75	124	May 17	H. R. Daubenspeck..	2.5	400
Mar. 10	G. N. Burrell........	3.72	1,200	Aug. 10	G. N. Burrell........	1.95	153

Daily discharge, in second-feet, of Miami River, at Tadmor, Ohio, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	268	232	169	530	1,680	971	649	1,260	876	2,830	431	143
2	268	232	199	477	2,780	710	1,220	2,040	1,050	1,700	387	143
3	268	232	199	431	2,780	710	3,220	1,500	822	530	344	169
4	305	232	199	350	2,780	649	2,570	1,360	526	431	305	199
5	305	199	199	1,590	2,780	649	2,120	2,680	632	387	199	169
6	268	199	199	7,560	2,780	477	3,860	3,100	956	431	169	143
7	268	199	268	4,880	2,780	431	1,990	2,570	1,490	649	143	143
8	268	199	344	3,170	2,780	530	1,440	1,600	1,050	477	117	143
9	268	199	344	2,310	2,780	530	1,040	1,170	573	431	143	143
10	268	199	344	1,910	2,780	530	1,040	763	646	387	169	143
11	268	199	344	1,930	2,780	996	649	986	477	344	169	117
12	268	169	344	1,840	2,780	5,030	530	530	387	477	169	117
13	232	169	344	1,840	2,780	4,590	477	387	431	665	143	117
14	232	169	305	2,020	2,780	12,000	431	305	649	5,660	143	117
15	232	169	305	2,020	2,780	8,190	387	268	772	8,170	143	117
16	232	143	305	2,020	2,780	4,570	344	232	477	5,980	143	117
17	232	143	305	2,020	2,780	3,110	344	169	431	4,420	117	117
18	268	143	305	2,020	2,780	1,910	344	199	431	3,280	117	117
19	268	143	305	2,020	2,780	1,200	305	199	387	2,680	117	143
20	268	117	305	2,020	1,360	971	268	199	305	1,930	95	143
21	268	117	305	2,020	1,680	1,040	232	203	199	1,040	95	143
22	232	117	305	2,380	913	1,510	232	441	199	772	143	117
23	232	143	305	2,380	1,850	1,460	232	936	344	649	199	177
24	232	143	205	2,380	3,850	3,930	232	990	530	477	232	117
25	232	143	305	2,380	2,040	3,190	268	454	477	477	199	117
26	232	143	305	2,380	1,600	2,040	305	387	477	530	143	143
27	232	143	647	2,380	1,360	1,040	305	390	477	649	117	143
28	232	143	1,430	1,360	1,200	710	305	834	670	589	143	143
29	232	169	1,310	971	....	649	268	1,340	5,570	530	199	117
30	232	169	1,040	710	....	530	268	757	4,780	477	268	117
31	232	....	1,040	710	....	431	....	487	....	431	190	....

Monthly discharge of Miami River at Tadmor, Ohio, for the year ending Sept. 30, 1917.

[Drainage area, 1,130 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	305	232	253	0.224	0.26
November	232	117	170	.150	.17
December	a 2,980	169	417	.369	.43
January	a 9,280	b 344	2,030	1.80	2.08
February	a 4,530	b 904	2,410	2.13	2.22
March	a 14,700	431	2,100	1.86	2.11
April	a 3,980	232	862	.763	.85
May	a 3,380	169	927	.820	.95
June	a 6,900	199	903	.799	.89
July	a 9,460	344	1,560	1,38	1.59
August	431	95	184	.163	.19
September	199	117	134	.119	.13
The year	a 14,700	95	991	.877	11.90

a Maximum discharge determined from special reading.
b Minimum discharge determined from special reading.

MIAMI RIVER AT DAYTON, OHIO.

LOCATION.—At Main Street Bridge, Dayton, Montgomery County, about half a mile below mouth of Mad River and 1 mile above mouth of Wolf Creek.

DRAINAGE AREA.—2,520 square miles (determined by Miami conservancy district).

RECORDS AVAILABLE.—March 18, 1905, to December 31, 1909; April 1, 1913, to September 30, 1917.

GAGE.—Vertical staff attached to downstream end of first pier from left bank; read by C. E. Wilson. Sea-level elevation of zero of gage, 723.73 feet.

DISCHARGE MEASUREMENTS.—Made from bridge.

CHANNEL AND CONTROL.—Control apparently shifts considerably at high stages and not so much at low stages. Weeds in the channel sometimes affect stage-discharge relation.

EXTREMES OF STAGE.—The flood of March–April, 1913, reached a stage of 29.0 feet on March 26, as determined by the Miami Conservancy District.

ICE.—Ice may affect the stage-discharge relation during severe winters.

DIVERSIONS.—A power plant about a mile above the station may divert water around the section, and a dam on Mad River about 2 miles above the station diverts water into the Miami & Erie Canal.

ACCURACY.—Stage-discharge relation not permanent; probably affected by ice during the latter part of December and the first part of February. Additional measurements needed in order to define curve for 1917. Gage read daily to tenths.

COOPERATION.—Gage-height record furnished by the United States Weather Bureau. Results of discharge measurements furnished by the Miami Conservancy District.

Discharge measurements of Miami River at Dayton, Ohio, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Mar. 30	G. N. Burrell	2.68	2,170
May 31	H. R. Daubenspeck	2.55	2,030
June 30	G. N. Burrell	5.75	8,160

Discharge measurements of Miami and Erie Canal at Dayton, Ohio, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
May 2	G. N. Burrell	....	a 126
24	H. R. Daubenspeck	....	a 96

a Warren Street bridge.

Daily gage height, in feet, of Miami River at Dayton, Ohio, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.2	0.6	0.9	1.6	3.9	2.7	2.2	3.0	2.8	4.3	1.7	1.0
2	.9	.6	.9	1.6	3.8	2.3	3.0	4.7	2.7	3.5	1.6	.9
3	.9	.6	.9	1.5	4.0	3.0	5.4	3.5	2.6	2.7	1.5	.9
4	.9	.6	.9	1.5	4.0	2.5	4.4	2.9	2.1	2.2	1.3	.8
5	.9	.6	1.0	5.0	4.0	2.0	3.9	5.0	2.5	1.9	1.2	.8
6	.9	.6	1.0	8.9	4.0	1.8	5.1	5.2	2.7	1.7	1.1	.8
7	.9	.6	1.0	6.4	4.0	1.7	4.6	4.3	3.1	1.8	1.1	.8
8	.9	.6	1.2	4.9	4.0	2.0	4.2	3.4	3.2	3.0	1.1	.8
9	1.0	.6	1.3	4.0	4.0	2.9	3.4	3.2	2.6	2.8	1.1	1.0
10	1.0	.7	1.3	3.8	3.8	2.8	3.0	2.9	2.7	2.3	1.0	.8
11	.9	.7	1.3	3.6	3.4	2.9	2.8	2.7	2.5	2.1	1.0	.8
12	.9	.7	1.4	2.9	2.7	6.4	2.6	2.5	2.4	2.0	1.0	.8
13	.9	.7	1.4	2.5	2.6	5.1	2.4	2.3	2.1	2.0	1.0	.7
14	.9	.7	1.3	3.1	2.4	10.5	2.3	2.2	2.0	2.7	1.1	.7
15	.8	.7	1.3	2.8	1.8	8.7	2.2	2.0	1.9	9.0	1.0	.7
16	.8	.7	1.3	3.5	1.7	6.0	2.1	1.9	1.8	6.4	.9	.7
17	.8	.7	1.3	3.6	1.7	4.9	1.9	1.8	1.8	5.0	.7	.7
18	.8	.7	1.3	3.6	1.6	4.3	2.1	1.8	1.6	4.9	.7	.7
19	.8	.7	1.3	3.4	1.5	3.5	3.2	1.7	1.6	3.6	.7	.7
20	1.0	.7	1.3	3.0	2.1	3.0	2.7	1.7	1.5	3.0	.7	.7
21	1.0	.6	1.3	2.1	2.7	3.0	2.8	1.6	1.5	2.7	.7	.7
22	.9	.6	1.3	3.9	2.5	3.8	2.8	2.3	1.5	2.4	1.3	.7
23	.9	.7	1.3	4.1	2.4	3.5	2.1	2.5	1.4	2.1	1.7	.7
24	.9	1.1	1.3	3.8	5.5	5.4	2.0	2.7	3.5	2.1	1.4	.7
25	.8	1.0	1.3	3.1	4.1	5.0	2.4	2.2	3.3	2.0	1.2	.7
26	.8	1.0	1.3	2.7	3.1	4.1	2.7	1.8	2.4	2.9	1.2	.6
27	.7	.9	1.8	2.1	2.9	3.6	2.9	2.0	2.0	2.9	1.1	.6
28	.7	.9	3.0	2.2	3.0	3.1	2.5	2.8	3.3	2.4	1.0	.6
29	.7	1.0	2.9	2.1	....	2.7	2.3	3.3	7.4	2.2	.9	.6
30	.7	1.2	2.2	3.5	....	2.5	2.2	3.0	6.1	1.7	1.0	.6
31	.7	....	1.9	4.0	....	2.3	....	2.6	....	1.7	1.0	....

MIAMI RIVER AT FRANKLIN, OHIO.

Location.—In NW. ¼ sec. 3, T. 1 N., R. 5 E., at suspension bridge on Second Street at Franklin, Warren County. Twin Creek enters about 2¾ miles downstream.

Drainage area.—2,780 square miles (Miami Conservancy District).

Records available.—March 15, 1916 to September 30, 1917.

Gage.—Vertical staff in two sections. Lower section reading 0–12.45 feet bolted to downstream side of old stone abutment on east side of river. Upper section nailed to south side of telephone pole 25 feet below east end of bridge. Read by Mrs. John Coleman. Sea-level elevation of zero of gage 658.41 feet.

Discharge measurements.—Made from downstream side of suspension bridge. Current very sluggish at low stages and low-water measurements are subject to error on that account.

Channel and control.—The principal control consists of a boulder and gravel bar one-half mile below the gage, free from vegetation and apparently permanent.

Extremes of discharge.—Maximum discharge during year, 30,500 second-feet in March; minimum discharge, 460 second-feet in September.

Highest stage known 23.0 feet on March 26, 1913.

Ice.—Stage-discharge relation affected by ice during severe winters.

Regulation.—See "Diversions."

Diversions.—Some water is diverted from the river 2 miles above the gage but it is returned to the river about 800 feet above the station. There is little or no flow in the Miami & Erie Canal at this place.

Accuracy.—Stage-discharge relation practically permanent; probably not affected by ice during the year. Rating curve well defined. Gage read to tenths once daily. Daily discharge ascertained by applying daily-gage height to rating table. Daily discharge as computed by the Miami Conservancy District is published. During rises special gage readings are made which are used in obtaining the mean daily discharge. The maximum monthly discharge in the table of monthly discharge for many months is the discharge corresponding to one of these special readings and does not therefore correspond to the maximum mean daily discharge as given in the table of daily discharge. Records excellent.

Cooperation.—Base data and computed daily discharge furnished by Miami Conservancy District.

Discharge measurements of Miami River at Franklin, Ohio, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec-ft.*			*Feet.*	*Sec.-ft.*
Nov. 6	H. R. Daubenspeck..	1.10	516	June 1	H. R. Daubenspeck..	2.85	2,570
Mar. 3	G. N. Burrell........	2.20	1,590	Aug. 1	G. N. Burrell........	1.80	1,170

Daily discharge, in second-feet, of Miami River at Franklin, Ohio, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,000	630	460	1,400	5,210	2,630	1,880	2,970	2,470	5,880	1,200	540
2	900	630	460	1,100	4,220	2,470	2,800	6,310	2,800	4,610	1,200	540
3	900	630	460	1,200	3,680	2,470	7,800	4,610	2,320	2,800	1,200	540
4	900	630	460	1,200	2,470	1,400	6,570	3,140	1,880	2,800	1,200	540
5	900	630	720	7,730	2,170	1,400	4,830	6,790	4,610	2,470	900	540
6	900	630	720	18,820	2,170	1,400	7,120	8,360	4,610	1,400	900	460
7	900	630	720	13,410	2,170	1,200	8,490	6,080	3,500	1,400	900	460
8	900	540	900	7,630	2,170	1,500	5,420	4,610	3,680	900	810	460
9	900	540	900	5,640	2,170	2,800	4,040	3,320	2,800	2,800	810	460
10	900	540	900	5,010	2,170	2,800	3,320	3,140	2,630	2,020	810	460
11	900	540	900	4,040	2,020	3,140	2,630	2,630	2,020	2,020	720	460
12	810	540	900	3,860	2,020	10,160	2,470	2,020	1,880	1,490	720	460
13	810	540	900	3,680	1,880	13,210	2,320	1,880	1,750	1,400	630	460
14	810	540	900	3,140	1,880	26,600	2,020	1,750	1,500	4,910	630	460
15	720	540	900	2,800	1,880	24,200	1,880	1,750	1,400	17,650	630	460
16	720	540	720	2,800	1,880	12,560	1,750	1,620	1,400	11,700	630	460
17	720	540	720	2,630	1,880	9,940	1,400	1,400	1,400	8,020	630	460
18	630	540	720	2,320	1,000	5,890	1,400	1,300	1,300	7,070	630	460
19	630	540	720	2,020	1,100	4,220	1,500	1,300	1,300	4,610	630	460
20	630	540	720	1,880	1,750	4,220	2,630	1,200	1,300	3,680	630	630
21	630	540	720	1,750	2,320	4,220	2,470	1,200	1,200	2,800	540	540
22	630	540	720	6,480	2,170	4,220	2,020	1,300	1,200	2,170	900	540
23	630	460	720	5,350	3,270	4,340	1,750	1,620.	1,100	1,880	1,400	540
24	720	460	630	4,410	7,900	7,560	1,620	2,630	4,220	1,880	1,400	540
25	720	460	630	2,800	6,210	8,720	1,880	2,020	3,680	1,400	900	540
26	720	460	720	2,470	3,500	5,420	2,320	1,880	2,020	1,400	900	540
27	630	460	3,000	2,020	2,800	4,410	2,320	2,630	1,500	2,800	900	540
28	630	460	3,500	2,020	2,800	3,500	2,470	2,800	2,630	2,020	720	540
29	630	460	3,140	2,470	....	2,800	2,020	4,220	12,700	2,020	720	540
30	630	460	2,970	2,800	....	2,320	1,880	2,800	10,870	2,020	630	460
31	630	....	2,320	5,210	....	2,020	....	2,470	....	2,020	540	....

Monthly discharge of Miami River at Franklin, Ohio, for the year ending Sept. 30, 1917.

[Drainage area, 2,780 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,000	630	764	0.275	0.32
November	630	460	540	.194	.22
December	3,500	460	1,090	.392	.45
January	a 20,900	1,100	4,200	1.51	1.74
February	a 8,810	1,000	2,740	.986	1.03
March	a 30,500	1,200	5,930	2.13	2.45
April	a 9,400	1,400	3,090	1.11	1.24
May	a 8,520	1,200	2,960	1.06	1.22
June	a 14,300	1,100	2,920	1.05	1.17
July	a 19,300	900	3,610	1.30	1.50
August	1,400	540	837	.301	.35
September	630	460	503	.181	.20
The year	a 30,500	460	2,440	.878	11.89

a From special gage readings.

MIAMI RIVER AT HAMILTON, OHIO.

LOCATION.—At single-span highway bridge on High Street at Hamilton, Butler County.

DRAINAGE AREA.—3,580 square miles.

RECORDS AVAILABLE.—February 28, 1910, to September 30, 1917. Flood stages only, November 16, 1904, to February 27, 1910, reported by United States Weather Bureau.

GAGE.—Vertical staff attached to a single pile about 75 feet above High-Main Street bridge reading from 0 to 10 feet. A staff fastened to an oak sleeper in the left concrete river wall just above the new bridge reads from 10 feet to 27 feet. Sea-level elevation of zero of gage, 564.63 feet. For description of old gage, see Water-Supply Paper 353.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge.

CHANNEL AND CONTROL.—Apparently permanent under ordinary conditions. The section at the bridge shifts somewhat during floods on account of the high velocity.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.8 feet at 5 p. m. March 13 (discharge, 37,000 second-feet); minimum stage, 1.9 feet September 17-18, 19, 30 (discharge, 370 second-feet).

The maximum stage on record at this station occurred at 3 a. m. March 26, 1913, at gage height 34.6 feet.

According to records of United States Weather Bureau, the highest stage prior to 1913 was 21.2 feet March 24, 1898.

ICE.—Stage-discharge relation affected by ice for short periods during severe weather only, as factory wastes probably keep the temperature of the water above the freezing point.

DIVERSIONS.—The Miami & Erie Canal is fed by water taken from Miami River at Middletown, Ohio. The quantity diverted is about 120 second-feet as shown by discharge measurements made during the summer of 1916.

REGULATION.—There are several power plants in Hamilton above the station, but all the water is returned to the river above the gage.

ACCURACY.—Stage-discharge relation practically permanent; effect of ice is considered negligible. Rating curve fairly well defined between 900 second-feet and 62,000 second-feet. Gage read to tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except as noted. Records excellent.

COOPERATION.—Results of discharge measurements furnished by Miami Conservancy District.

Discharge measurements of Miami River at Hamilton, Ohio, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 30	G. N. Burrell[a]	2.05	433	July 24	B. E. Jones	3.00	2,05
Mar. 28	.....do	4.00	4,140	Aug. 6	G. N. Burrell[a]	2.44	1,05
June 7	H. R. Daubenspeck[a]	4.40	5,610				

[a] Engineers of Miami Conservancy District.

Discharge measurements of Miami & Erie Canal at Hamilton, Ohio, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 30	G. N. Burrell	....	105	June 8	H. R. Daubenspeck	....	10
Mar. 28	.....do	....	116	Aug 6	G. N. Burrell	....	12

NOTE.—At High Street bridge.

Daily discharge, in second-feet, of Miami River at Hamilton, Ohio, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	830	700	700	1,720	6,910	3,340	3,100	3,840	3,340	7,650	970	700
2	830	700	700	1,450	4,910	3,100	7,650	6,910	4,350	6,200	970	580
3	830	580	700	1,540	3,340	3,100	9,150	4,910	4,090	4,090	830	970
4	830	580	700	1,450	3,100	2,870	7,650	5,850	3,340	3,340	830	700
5	830	580	700	23,900	2,870	2,650	8,020	9,900	20,800	3,100	830	580
6	700	580	700	23,900	3,100	2,440	10,300	10,300	8,780	2,870	830	470
7	700	580	700	14,600	3,340	2,220	9,900	7,280	5,520	2,870	830	580
8	700	580	830	9,900	3,340	2,440	6,910	5,520	4,910	2,870	700	1,040
9	700	580	970	6,910	3,100	4,090	4,910	4,350	5,520	3,840	700	640
10	700	580	830	5,520	2,870	3,840	4,350	3,840	6,200	3,840	700	470
11	700	580	830	4,620	2,760	6,550	3,840	3,340	4,090	3,100	700	470
12	700	580	830	3,590	2,650	16,200	3,340	2,760	3,340	3,100	700	470
13	700	580	830	2,760	2,500	26,200	2,870	2,650	2,870	3,100	580	470
14	700	580	700	2,650	2,350	32,200	2,540	2,440	3,340	4,910	580	470
15	700	700	580	2,650	2,200	25,700	2,220	2,120	2,760	18,200	580	470
16	700	700	470	2,500	2,020	13,800	2,020	2,020	2,440	12,200	580	450
17	700	700	470	2,350	2,020	9,900	2,020	1,820	2,220	13,800	525	370
18	700	700	470	2,200	2,020	7,650	2,760	1,820	2,020	7,650	525	370
19	700	700	470	2,020	2,330	5,520	3,590	1,630	2,020	5,210	525	420
20	700	700	470	2,020	2,650	4,350	3,340	1,450	1,820	4,350	525	470
21	700	700	470	2,020	2,650	4,350	3,100	1,280	1,820	3,840	604	470
22	700	700	470	14,600	2,650	5,210	2,870	1,450	1,630	3,340	1,450	470
23	700	700	470	7,650	7,650	7,280	2,870	3,100	1,450	3,100	2,020	470
24	700	700	470	5,520	10,600	11,000	2,650	2,870	4,350	2,220	1,200	470
25	700	700	470	4,910	6,200	9,520	2,650	2,870	4,350	1,720	970	470
26	700	700	470	3,590	4,350	6,910	2,650	2,870	3,100	2,760	900	470
27	700	700	7,650	3,100	3,840	5,210	3,590	4,090	3,100	3,340	700	470
28	700	700	4,910	3,100	3,340	4,350	3,100	8,400	4,350	2,330	700	470
29	700	700	3,340	4,910	....	3,590	2,870	6,200	9,900	1,820	700	470
30	700	700	2,760	6,200	....	2,870	2,650	4,350	12,200	1,360	700	420
31	700	....	2,120	6,910	....	2,760	....	3,840	....	1,040	700	....

NOTE.—Daily discharge interpolated because of missing gage readings as follows: Jan. 16–18, 20, Feb. 4, 6, 11, 13–15.

Monthly discharge of Miami River at Hamilton, Ohio, for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.		Maximum.	Minimum.	Mean.
October	830	700	721	May	10,300	1,280	4,070
November	700	580	652	June	20,800	1,450	4,670
December	7,650	470	1,200	July	18,200	1,040	4,620
January	23,900	1,450	5,830	August	2,020	525	795
February	10,600	2,020	3,630	September	1,040	370	527
March	32,200	2,220	7,780				
April	10,300	2,020	4,320	The year	32,200	370	3,240

MIAMI RIVER AT VENICE, OHIO.

LOCATION.—About 400 feet downstream from boundary line between Hamilton and Butler counties, at single span highway bridge three-fourths mile southeast of Venice, Butler County. Indian Creek enters from right about 1.4 miles above station.

DRAINAGE AREA.—3,790 square miles (measured by U. S. Army Engineers).

RECORDS AVAILABLE.—June 14, 1915, to September 30, 1917.

GAGE.—Chain gage fastened to downstream side of bridge; read by H. B. Matson.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—The control for medium stages is the remains of an old mill dam about 1¼ miles below the gage. For stages below about 3 feet a riffle is formed by an unstable gravel bar under the bridge. This bar scours out during high water and reforms at low stages. All water flows under the bridge for stages less than 25 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 17.7 feet at 7 a. m. March 14 (discharge, 35,600 second-feet); minimum stage, 1.13 feet at 4.30 p. m. November 14 (discharge, about 465 second-feet).

The highest stage known corresponds to about 38 feet on the gage during the 1913 flood.

DIVERSIONS.—The Miami & Erie Canal is fed by water taken from Miami River at Middletown and Miamisburg, Ohio. The canal at Lindenwald near the point where it leaves the drainage basin has a flow of about 100 second-feet which is a considerable part of the low-water flow of Miami River.

REGULATION.—The flow during low stages is probably regulated to a large extent by power plants in Hamilton.

ACCURACY.—Stage-discharge relation practically permanent except for possible slight changes at low stage because of shifts in the gravel bar at the bridge; probably not affected by ice during the year. Rating curve well defined between 460 and 35,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

COOPERATION.—Base data furnished by the United States Engineer Corps.

The following discharge measurement was made by L. M. Crosley:

November 8, 1917: Gage height, 1.33 feet; discharge, 516 second-feet.

Daily discharge, in second-feet, of Miami River at Venice, Ohio, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	900	595	678	1,800	7,260	3,490	3,080	4,080	3,640	6,900	1,340	798
2	798	568	650	1,610	5,860	2,820	7,620	6,720	4,710	7,800	1,260	765
3	830	568	622	1,610	2,820	2,450	9,070	5,520	4,390	3,930	1,180	1,110
4	765	568	595	1,520	2,450	2,450	8,160	6,030	3,080	2,690	1,110	868
5	765	540	705	20,400	1,700	2,000	7,800	9,620	11,800	2,110	970	798
6	765	515	765	23,700	2,330	1,700	10,000	9,810	9,810	1,800	970	735
7	735	542	798	14,700	2,450	2,000	10,000	7,800	6,550	2,000	1,080	735
8	705	568	970	9,620	2,570	3,210	7,440	6,200	5,520	2,820	970	1,520
9	735	595	1,040	7,260	2,220	3,780	6,030	4,710	6,380	3,080	870	830
10	705	595	970	6,200	1,700	4,240	5,030	3,490	5,520	2,450	870	765
11	678	622	900	5,360	1,610	5,690	4,240	3,640	4,390	2,220	870	765
12	678	568	970	3,780	1,520	18,600	3,490	3,080	3,490	2,000	870	735
13	678	568	935	2,950	1,520	25,400	3,350	2,570	3,080	2,000	780	735
14	678	490	900	2,450	1,340	34,000	2,950	2,570	2,950	5,690	798	735
15	650	540	830	2,330	1,520	26,900	2,330	2,330	2,450	15,200	798	735
16	622	595	798	2,220	1,430	14,700	2,330	2,110	2,220	11,600	798	705
17	650	595	735	2,220	1,430	10,800	2,330	2,000	2,110	13,500	798	705
18	622	595	705	2,110	1,520	8,340	2,220	1,800	1,800	8,160	765	735
19	705	540	735	1,900	2,000	6,200	3,640	1,800	1,700	5,860	765	705
20	765	515	678	1,800	2,690	5,190	3,640	1,700	1,610	4,080	735	705
21	798	595	705	2,110	2,570	4,710	3,080	1,520	1,520	3,210	765	705
22	678	595	678	16,500	3,080	5,860	2,820	1,700	1,430	2,690	1,340	705
23	705	650	650	8,160	7,800	7,260	2,450	2,450	1,430	2,220	2,450	678
24	765	650	622	6,380	9,440	11,600	2,220	2,950	2,450	2,000	1,260	705
25	735	735	568	5,360	7,440	10,000	2,330	2,570	3,780	1,900	970	705
26	678	735	622	3,930	4,390	7,620	2,690	2,000	2,570	2,950	970	705
27	650	622	6,550	3,210	4,080	6,200	3,350	3,930	2,110	3,930	830	705
28	650	650	5,360	3,640	4,080	5,030	3,210	8,880	3,490	2,570	798	705
29	650	650	3,490	5,030	....	4,080	2,950	7,800	8,700	1,900	765	705
30	595	678	2,330	6,900	....	3,490	2,570	5,190	9,620	1,610	798	735
31	678	....	2,220	7,260	....	3,080	....	3,930	....	1,430	798	....

Monthly discharge of Miami River at Venice, Ohio, for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.		Maximum.	Minimum.	Mean.
October	900	595	710	May	9,810	1,520	4,210
November	735	490	595	June	11,800	1,430	4,140
December	6,550	568	1,280	July	15,200	1,430	4,270
January	23,700	1,520	5,940	August	2,450	735	979
February	9,440	1,340	3,240	September	1,520	678	774
March	34,000	1,700	8,160				
April	10,000	2,220	4,410	The year	34,000	490	3,230

LORAMIE CREEK AT LOCKINGTON, OHIO.

Location.—In NE. ¼ sec. 30, T. 7 N., R. 6 E., at steel highway bridge, half a mile northwest of Lockington, Shelby County, and 1½ miles below mouth of Turtle Creek.

Drainage area.—255 square miles (measured by Miami Conservancy District).

Records available.—September 13, 1915, to September 30, 1917.

Gage.—Vertical staff in two sections; lower section reading 0–10.45 feet, bolted to downstream face of pier; upper section fastened to a tree 100 feet southwest of west end of bridge. Read by Vernon Jones. Sea-level elevation of zero of gage, 875.99 feet.

Discharge measurements.—Made from downstream side of bridge or by wading.

Channel and control.—The principal control is a sand and gravel bar about 100 feet below the gage and is liable to shift. During summer months flow is affected somewhat by a growth of vegetation along the edge of the stream.

EXTREMES OF STAGE.—Highest stage known, 15.6 feet March 25, 1913.

ICE.—The creek is frozen over during severe winters.

DIVERSIONS.—The summit level of the Miami & Erie Canal is supplied by water from the Loramie reservoir. Consequently, water is diverted from Loramie Creek to Lake Erie drainage. There is no flow in the Miami & Erie Canal at Lockington, as the 1913 flood destroyed the canal embankment at a number of places, and no repairs have been made.

REGULATION.—There is a small amount of regulation, due to the storage of water in Loramie reservoir, which controls about 30 per cent of the total drainage area of Loramie Creek.

ACCURACY.—Stage-discharge relation not permanent; not seriously affected by ice during the year. Rating curve not developed. Measurements indicate considerable change in the control. Gage read to tenths once daily. Records good.

COOPERATION.—Base data furnished by Miami Conservancy District.

Discharge measurements of Loramie Creek at Lockington, Ohio, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 26	H. R. Daubenspeck..	1.35	14.2	July 14	B. H. Petty..........	5.8	3,310
Mar. 8	G. N. Burrell.........	2.20	297	17	H. R. Daubenspeck..	3.9	1,410
May 15	H. R. Daubenspeck..	1.5	61.4	17	.....do...............	3.85	1,410
June 4	.....do...............	1.5	75.8	19	.....do...............	1.98	173
30	.....do...............	3.88	1,330				

Daily gage height, in feet, of Loramie Creek at Lockington, Ohio, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.4	1.3	1.3	1.7	3.0	2.0	1.9	3.1	1.9	3.0	1.5	1.0
2	1.4	1.3	1.3	1.7	3.0	2.0	2.8	2.8	1.8	2.4	1.5	1.0
3	1.4	1.3	1.3	1.6	3.0	1.9	2.5	2.5	1.8	2.0	1.5	1.0
4	1.3	1.3	1.3	1.5	3.0	1.7	2.1	2.1	1.5	1.7	1.5	1.0
5	1.3	1.3	1.8	5.0	3.0	1.7	2.0	4.0	1.5	1.5	1.5	1.0
6	1.3	1.3	1.8	4.8	3.0	1.7	1.9	3.6	2.0	1.5	1.4	1.0
7	1.3	1.3	1.7	4.0	3.0	1.8	1.9	2.9	2.8	2.8	1.4	1.0
8	1.3	1.3	1.7	3.4	3.0	2.0	1.8	2.6	2.2	2.4	1.4	1.0
9	1.3	1.3	1.6	3.1	2.5	2.3	1.8	2.4	1.7	1.8	1.3	1.0
10	1.3	1.3	1.6	2.9	2.5	2.0	1.6	2.2	1.7	1.5	1.3	1.0
11	1.3	1.3	1.6	2.6	2.0	2.5	1.5	1.8	1.7	1.5	1.2	1.0
12	1.3	1.3	1.5	2.3	1.8	3.9	1.5	1.8	1.6	1.5	1.1	1.0
13	1.3	1.3	1.5	2.0	1.5	4.0	1.5	1.8	1.6	1.5	1.0	1.0
14	1.3	1.3	1.5	2.0	1.3	6.0	1.5	1.7	1.6	6.6	1.0	1.0
15	1.3	1.3	1.4	2.0	1.3	4.4	1.5	1.7	1.5	5.7	1.0	1.0
16	1.3	1.3	1.4	2.1	1.3	3.6	1.5	1.6	1.5	4.7	1.0	1.0
17	1.3	1.3	1.4	2.3	1.3	2.8	1.5	1.6	1.5	4.0	1.0	1.0
18	1.3	1.3	1.4	2.4	1.6	2.0	2.1	1.5	1.5	3.0	1.0	1.0
19	1.3	1.3	1.4	2.4	1.9	1.7	1.8	1.5	1.5	2.1	1.0	1.0
20	1.5	1.3	1.4	2.4	2.2	1.7	1.9	1.5	1.5	2.0	1.0	1.0
21	1.9	1.3	1.4	2.4	2.4	1.9	1.9	2.6	1.5	2.0	1.0	1.0
22	1.6	1.3	1.4	2.8	2.4	1.9	1.8	2.6	1.5	1.8	1.0	1.0
23	1.5	1.3	1.4	3.1	2.8	2.3	1.8	2.8	1.5	1.7	1.0	1.0
24	1.4	1.3	1.4	2.8	3.5	3.7	1.7	2.6	3.2	1.5	1.0	1.0
25	1.4	1.3	1.4	2.8	2.7	3.0	2.0	2.3	2.0	1.5	1.0	1.0
26	1.3	1.3	1.4	2.6	2.3	2.8	2.2	2.0	1.8	1.5	1.0	1.0
27	1.3	1.3	1.6	2.3	2.1	2.6	2.5	2.4	1.8	1.5	1.0	1.0
28	1.3	1.3	3.3	2.0	2.1	2.2	2.3	2.5	2.0	1.5	1.0	1.0
29	1.3	1.3	2.3	2.1	......	1.9	1.9	2.3	4.9	1.5	1.0	1.0
30	1.3	1.3	2.0	2.5	......	1.7	1.8	2.0	4.0	1.5	1.0	1.0
31	1.3	......	1.9	2.8	......	1.7	......	2.0	......	1.5	1.0	......

STILLWATER RIVER AT PLEASANT HILL, OHIO.

Location.—At steel highway bridge, about three-fourth mile northwest of Pleasant Hill, Miami County, in SE. ¼ sec. 18, T. 7 N., R. 5 E., 4 miles below mouth of Greenville Creek.

Drainage area.—453 square miles (Miami Conservancy District).

Records available.—April 7, 1916, to September 30, 1917.

Gage.—Vertical staff gage in two sections—0 to 10.27 feet bolted to downstream face of pier, 10.27 feet to 20.25 feet bolted to face of downstream wing wall of left abutment. Read by Elmer Herbst.

Discharge measurements.—Made from downstream side of bridge or by wading below the bridge.

Channel and control.—The control is formed of compact rock and gravel about 1,000 feet below the gage; apparently permanent. Channel is straight above and below the bridge. During high floods the water overflows the levee on the left bank and spreads over a wide strip of bottom land.

Extremes of discharge.—Maximum discharge during year, 7,190 second-feet in March; minimum discharge, 10 second-feet in November, December, and January. The highest stage on record, 17.5 feet by present gage, occurred March 25, 1915.

Ice.—Stage-discharge relation occasionally affected by ice.

Accuracy.—Stage-discharge relation probably permanent; may be affected by ice to some extent during portions of December and January. Rating curve well defined from 28 second-feet to 8,800 second-feet; extended beyond these limits. Gage read to tenths daily. Daily discharge ascertained by applying daily gage height to rating table. The daily discharge as computed by Miami Conservancy District is published. During rises special gage readings are made which are used in obtaining the mean daily discharge. The maximum monthly discharge in the table of monthly discharge for many months is the discharge corresponding to one of these special readings and does not, therefore, correspond to the maximum mean daily discharge as listed in the table of mean daily discharge. Records are considered excellent except for periods possibly affected by ice.

Cooperation.—Base data and mean daily discharge are furnished by the Miami Conservancy District.

Discharge measurements of Stillwater River at Pleasant Hill, Ohio, during the years ending Sept. 30, 1916 and 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1916.		*Feet.*	*Sec-ft.*	1917.		*Feet.*	*Sec-ft.*
May 9	H. R. Daubenspeck..	5.32	1,680	Mar. 1	G. N. Burrell........	2.80	227
June 3	G. N. Burrell........	3.25	420	14	E. W. Lane..........	10.44	6,860
July 5	H. R. Daubenspeck..	2.05	130	15	H. R. Daubenspeck..	7.08	3,300
31	G. N. Burrell........	1.80	53.0	16	G. N. Burrell........	5.30	1,710
Aug. 30	.....do..............	1.60	34.8	June 29	B. H. Petty..........	7.32	3,470
Oct. 25	.....do..............	1.82	60.6	July 14	H. R. Daubenspeck..	9.2	5,480

Daily discharge, in second-feet, of Stillwater River at Pleasant Hill, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	34	24	10	10	357	283	318	2,590	200	1,440	157	19
2	45	24	10	13	357	252	400	1,960	200	1,160	119	34
3	34	34	13	34	357	252	1,440	1,300	200	785	119	45
4	24	24	24	87	318	252	1,230	580	200	318	87	45
5	24	24	45	3,190	318	224	1,020	2,260	252	318	87	45
6	34	24	45	4,220	357	224	2,120	2,300	318	283	87	34
7	24	34	45	2,120	318	200	2,030	1,680	785	224	57	45
8	24	34	34	785	283	630	1,770	785	580	252	57	45
9	34	45	34	580	252	690	1,440	630	580	318	34	34
10	24	45	45	680	252	680	1,230	488	318	630	34	34
11	24	34	45	488	224	1,290	1,090	400	283	488	34	34
12	24	34	34	488	200	2,180	785	318	252	680	34	24
13	34	24	34	488	200	3,630	488	252	252	910	34	24
14	34	34	34	445	224	6,960	318	252	224	4,490	19	24
15	34	34	24	400	200	4,570	252	200	200	3,920	19	34
16	34	45	24	400	200	1,980	224	200	200	1,370	19	24
17	45	34	24	400	200	1,340	252	200	200	962	19	24
18	34	34	24	318	178	785	488	157	200	785	19	24
19	57	24	24	318	178	630	785	178	178	630	13	24
20	72	24	34	318	157	488	785	157	178	531	13	34
21	57	19	24	580	137	630	680	157	200	400	13	102
22	45	19	24	1,300	137	580	580	318	200	318	19	72
23	45	24	24	1,230	318	630	488	580	1,060	252	200	34
24	34	24	24	1,090	1,940	2,300	680	488	1,530	224	157	34
25	24	24	19	962	1,230	1,770	1,300	318	680	224	119	45
26	34	19	19	785	400	1,300	1,680	318	580	200	87	45
27	24	19	13	680	400	580	900	252	785	200	87	45
28	24	13	13	400	318	400	733	252	1,390	200	57	34
29	34	13	13	252	....	318	580	224	4,120	157	57	34
30	34	10	13	252	....	318	1,160	224	2,350	157	34	34
31	24	....	10	283	....	318	....	252	....	157	19	....

Monthly discharge of Stillwater River at Pleasant Hill, Ohio, for the year ending Sept. 30, 1917.

[Drainage area, 453 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	72	24	34.6	0.076	0.09
November	45	10	27.2	.060	.07
December	45	10	25.9	.057	.07
January	4,220	10	761	1.68	1.94
February	1,940	137	358	.790	.82
March	7,190	200	1,180	2.60	3.00
April	2,120	224	908	2.00	2.23
May	3,340	157	654	1.44	1.66
June	5,500	178	623	1.38	1.54
July	6,050	157	742	1.64	1.89
August	200	13	61.6	.136	.16
September	102	19	37.6	.083	.09
The year	7,190	10	452	0.998	13.56

STILLWATER RIVER NEAR WEST MILTON, OHIO.

Location.—In SE. ¼ sec. 4, T. 4 N., R. 5 E., 1 mile below mouth of Ludlow Creek, entering from right, at bridge of Cleveland, Cincinnati, Chicago & St. Louis Railway (Peoria & Eastern division), about 2 miles north of West Milton, Miami County.

Drainage area.—600 square miles.

Records available.—January 1, 1914, to September 30, 1917.

Gage.—Vertical staff in two sections; read by M. J. Shellhaas. Sea-level elevation of zero of gage, 812.97 feet.

Discharge measurements.—Made from downstream side of railroad bridge at gage, from upstream side of highway bridge about 300 feet below the gage, or by wading.

CHANNEL AND CONTROL.—Regular section shifts slightly during high water; weeds during the summer may affect the stage-discharge relation.

EXTREMES OF STAGE.—Maximum daily stage recorded during year, 8.3 feet in March; mimimum daily stage, 0.5 foot in October.

The flood of March–April, 1913, reached a stage of 28 feet on March 25.

ICE.—Stage-discharge relation affected by ice during severe winters.

ACCURACY.—Stage-discharge relation changes during floods; affected by ice to some extent December 15–26 and January 13–21. Rating curve for 1917 not definitely defined. Gage read daily to tenths. Records good.

COOPERATION.—Gage-height record furnished by United States Weather Bureau. Results of discharge measurements furnished by the Miami Conservancy District.

Discharge measurements of Stillwater River near West Milton, Ohio, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec-ft.*			*Feet.*	*Sec.-ft.*
Mar. 22	G. N. Burrell........	3.00	1,220	July 26	B. E. Jones..........	2.36	686
May 21	H. R. Daubenspeck..	1.3	186	27	G. N. Burrell........	1.88	382

Daily gage height, in feet, of Stillwater River near West Milton, Ohio, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	0.9	1.2	1.0	1.7	2.5	1.8	1.9	3.6	2.0	2.5	1.6	0.7
2	.8	1.0	1.0	1.7	2.6	1.5	3.4	5.1	1.9	2.4	1.4	.7
3	.8	1.0	1.0	1.6	2.6	1.4	4.3	2.6	1.9	2.0	1.2	.7
4	.8	1.2	1.0	1.7	2.6	1.4	2.9	2.6	1.9	1.9	1.0	.7
5	.7	1.2	1.5	4.9	2.6	1.4	2.7	4.7	2.0	1.9	.9	.7
6	.7	1.3	1.4	6.0	2.6	1.4	4.0	4.2	2.5	1.7	.7	.7
7	.7	1.2	1.4	4.5	2.6	1.5	3.8	2.9	2.7	2.0	.7	.7
8	.6	1.2	1.5	3.1	2.6	1.9	3.0	2.6	2.4	2.9	.7	.7
9	.6	1.4	1.4	2.6	2.6	2.2	2.5	2.5	2.0	2.2	.7	.7
10	.6	1.4	1.4	2.6	2.6	2.3	2.2	2.2	2.0	2.1	.7	.7
11	.6	1.3	1.4	2.3	2.6	2.5	2.0	2.0	2.0	2.0	.7	.7
12	.6	1.1	1.3	2.3	2.6	4.7	2.0	2.0	2.0	2.2	.7	.7
13	.5	1.0	1.3	2.3	2.6	3.9	1.9	2.0	1.9	2.2	.7	.7
14	.5	.9	1.3	2.3	2.6	8.3	1.9	1.9	2.0	6.9	.7	.7
15	.6	.9	1.4	2.3	2.6	6.0	1.9	1.9	2.0	6.0	.7	.7
16	1.0	.9	1.4	2.3	2.6	3.9	1.9	1.7	2.0	3.2	.7	.7
17	1.1	.8	1.4	2.3	2.6	3.3	1.7	1.7	2.0	2.6	.7	.6
18	1.3	.8	1.4	2.3	2.2	2.7	2.4	1.6	1.9	2.7	.7	.6
19	1.5	.8	1.4	2.3	1.9	2.5	2.5	1.6	1.9	2.2	.7	.6
20	1.6	.8	1.4	2.3	2.0	2.4	2.4	1.6	1.7	2.0	.6	.6
21	1.7	.7	1.4	2.3	2.0	2.6	2.1	1.5	1.7	1.9	.7	2.3
22	1.6	.7	1.4	2.3	2.0	3.0	1.9	1.6	1.7	1.8	1.1	2.0
23	1.6	.9	1.4	2.7	2.3	2.6	1.9	2.0	3.1	2.0	1.2	2.0
24	1.6	1.0	1.4	2.5	4.8	4.4	2.0	1.9	3.9	1.9	1.3	2.0
25	1.5	1.0	1.4	2.3	2.6	3.4	2.5	1.7	2.7	1.7	1.2	1.9
26	1.5	1.0	1.4	2.0	2.0	2.8	3.4	1.7	2.5	2.9	1.1	1.9
27	1.5	1.1	2.0	1.9	2.1	2.4	2.5	1.7	2.6	2.0	.9	1.9
28	1.4	1.1	2.9	1.9	2.1	2.0	2.5	1.7	2.6	1.9	.7	2.0
29	1.4	1.0	2.7	2.0	....	1.9	2.0	1.9	5.7	1.8	.7	2.0
30	1.4	1.0	2.3	3.0	....	1.9	2.0	1.9	4.0	1.7	.7	2.0
31	1.3	....	1.9	2.9	....	1.8	....	1.9	....	1.6	.7	....

MAD RIVER NEAR SPRINGFIELD, OHIO.

LOCATION.—At old mill about 800 feet south of Cleveland, Cincinnati, Chicago & St. Louis Railway bridge No. 121 and one-third mile below mouth of Buck Creek, near Springfield, Clark County.

DRAINAGE AREA.—488 square miles.

RECORDS AVAILABLE.—December 31, 1903, to March 31, 1906; February 1, 1914, to September 30, 1917.

GAGE.—Vertical staff in two sections; lower section attached to north wall of rock-lined overflow channel from millrace; upper section attached to south side of old mill building; read by O. W. Bruney. Sea-level elevation of zero of gage, 887.81 feet. The station operated 1903 to 1906 was located about one mile down stream.

DISCHARGE MEASUREMENTS.—Made from highway bridge about 1,000 feet below gage or by wading about 1,500 feet below gage.

CHANNEL AND CONTROL.—Channel shifts slightly during floods.

EXTREMES OF STAGE.—Maximum daily stage recorded during year, 6.8 feet in July; minimum daily stage recorded, 1.1 feet September 26–30.

The flood of March–April, 1913, reached a stage on March 25 represented by 19.2 feet, referred to gage datum.

ICE.—Stage-discharge relation is affected by ice during severe winters.

ACCURACY.—Stage-discharge relation probably permanent, probably not seriously affected by ice during the year. Rating curve for 1917 not definitely defined. Gage read daily to tenths. Records good.

COOPERATION.—Gage-height record furnished by the United States Weather Bureau. Results of discharge measurements furnished by the Miami Conservancy District

Discharge measurements of Mad River near Springfield, Ohio, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec-ft.*			*Feet.*	*Sec-ft.*
Oct. 26	G. N. Burrell	1.35	197	Mar. 12	G. N. Burrell	3.45	898
Nov. 18	H. R. Daubenspeck	1.30	201	May 22	H. R. Daubenspeck	1.95	382
18	do	1.30	223	Aug. 8	G. N. Burrell	1.52	259

Daily gage height, in feet, of Mad River near Springfield, Ohio, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		1.3	1.3	1.8	2.0	2.0	2.2	3.6	2.3	3.5	1.7	1.4
2		1.3	1.3	1.8	2.0	1.9	3.3	3.2	2.3	3.2	1.6	1.4
3		1.3	1.3	1.8	2.0	1.8	3.2	3.0	2.5	3.2	1.6	1.4
4		1.3	1.3	1.8	2.0	1.8	3.2	2.8	3.2	3.1	1.5	1.3
5		1.3	1.4	6.3	2.0	1.7	3.1	2.6	3.6	2.8	1.5	1.3
6		1.3	1.5	4.9	2.0	1.6	3.0	2.3	2.8	1.8	1.5	1.3
7		1.3	1.5	3.7	2.0	1.6	2.8	2.3	2.1	2.0	1.5	1.3
8		1.3	1.5	3.5	2.0	2.6	2.7	2.3	2.1	1.9	1.4	1.3
9		1.3	1.5	3.3	2.0	2.4	2.4	2.3	1.9	1.8	1.4	1.3
10		1.3	1.4	3.0	2.0	2.2	2.2	2.3	1.9	2.0	1.5	1.3
11		1.3	1.4	2.7	2.0	2.5	2.2	2.3	1.8	1.8	1.5	1.3
12		1.3	1.4	2.5	2.0	3.6	2.1	2.3	1.8	2.4	1.5	1.3
13		1.3	1.4	2.5	2.0	3.4	2.1	2.2	1.8	1.9	1.5	1.3
14		1.3	1.4	2.5	2.0	6.5	2.0	2.0	1.8	6.8	1.5	1.3
15		1.3	1.4	2.5	2.0	4.2	2.0	1.9	1.8	4.6	1.4	1.3
16		1.3	1.4	2.5	2.0	4.0	2.0	1.8	1.8	3.0	1.5	1.2
17		1.3	1.4	2.3	2.0	3.8	2.0	1.8	1.8	2.9	1.4	1.2
18		1.3	1.4	2.3	2.0	3.5	4.0	1.8	1.8	3.0	1.4	1.2
19		1.3	1.4	2.3	3.9	3.4	2.4	1.8	1.9	2.6	1.3	1.2
20		1.3	1.4	2.3	2.9	3.2	2.3	1.9	1.9	2.5	1.3	1.2
21		1.3	1.4	2.3	2.7	3.5	2.2	2.0	2.0	2.4	1.3	1.2
22		1.3	1.4	2.3	2.3	3.2	2.2	2.3	2.3	2.3	1.5	1.2
23		1.4	1.5	2.1	1.9	2.9	2.2	2.2	2.5	2.1	1.5	1.2
24		1.4	1.6	2.0	3.6	2.7	2.2	2.1	2.3	1.9	1.5	1.2
25		1.4	1.9	2.0	2.3	2.6	2.3	2.0	2.4	1.7	1.4	1.2
26		1.3	3.2	2.0	2.1	2.6	2.3	2.0	2.4	2.5	1.3	1.1
27		1.3	1.8	2.0	2.0	2.4	2.3	2.0	2.5	2.3	1.3	1.1
28		1.3	1.8	2.0	2.0	2.4	2.2	2.7	2.8	2.0	1.3	1.1
29		1.4	1.8	2.6		2.2	2.2	2.6	5.7	1.9	1.3	1.1
30		1.3	1.8	2.4		2.2	2.2	2.3	3.5	1.7	1.4	1.1
31			1.8	2.0		2.2		2.6		1.7	1.4	

MAD RIVER NEAR DAYTON, OHIO.

LOCATION.—In SE. ¼ sec. 8, T. 2 E., R. 8 N. Great Miami base line, at covered highway bridge about a mile northwest of Wright, Greene County, and 5 miles above Dayton.

DRAINAGE AREA.—652 square miles.

RECORDS AVAILABLE.—November 19, 1914, to September 30, 1917.

GAGE.—Vertical staff, attached to the downstream side of west abutment of bridge; read by John Morris. Sea-level elevation of zero of gage, 783.91 feet.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge at gage or by wading about 150 feet above gage.

CHANNEL AND CONTROL.—Stream bed is made up of boulders and gravel; probably permanent.

EXTREMES OF DISCHARGE.—Maximum daily stage recorded during year, 7.4 feet March 14 (discharge, 5,250 second-feet); minimum daily stage, 0.8 foot September 28–30 (discharge, 209 second-feet).

The flood of March–April, 1913, the highest known to have occurred at this station, reached a stage on March 25, represented by 14.0 feet, referred to gage datum.

ICE.—Stage-discharge relation seldom affected by ice, as velocities are high.

ACCURACY.—Stage-discharge relation changed about March 15, 1917; not seriously affected by ice during the years 1915 and 1917. Rating curve used November 19, 1914, to March 14, 1917, failry well defined between 230 and 5,500 second-feet; that used from March 15 to September 30, 1917, well defined between 210 and 6,000 second-feet. Gage read daily to tenths. Daily discharge ascertained by applying daily gage height to rating table. Data for 1915 are republished on account of a revision of the rating curve, and supersede those published in Water-Supply Paper 403. Data as published for 1916 in Water-Supply Paper 433 are correct. Records good.

COOPERATION.—Gage-height record and results of discharge measurements furnished by Miami Conservancy District.

Discharge measurements of Mad River near Dayton, Ohio, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec-ft.*			*Feet.*	*Sec.-ft.*
Oct. 27	G. N. Burrell	1.20	256	May 18	H. R. Daubenspeck	1.55	471
Mar. 26	.....do	2.40	942	Aug. 10	G. N. Burrell	1.15	296

Daily discharge, in second-feet, of Mad River near Dayton, Ohio, for the years ending Sept. 30, 1915 and 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1914-15.												
1	......	......	225	410	1,500	520	265	265	410	465	410	310
2	......	......	195	310	4,810	520	265	225	575	1,300	410	310
3	......	......	225	310	3,650	520	265	225	575	575	410	310
4	......	......	195	265	1,910	465	265	225	465	465	410	265
5	......	......	740	265	1,500	520	265	225	410	740	360	410
6	......	......	685	265	4,590	1,170	265	225	360	575	360	1,980
7	......	......	575	3,260	2,220	980	265	310	410	410	360	920
8	......	......	520	1,100	1,300	980	265	265	410	4,700	360	740
9	......	......	520	740	1,100	740	265	265	410	3,750	630	630
10	......	......	465	520	980	685	265	265	310	1,300	465	2,220
11	......	......	465	520	920	630	465	265	310	980	410	920
12	......	......	410	520	2,380	630	410	265	265	860	740	630
13	......	......	360	465	2,900	575	410	265	265	685	630	520
14	......	......	360	410	1,770	520	360	225	265	630	465	520
15	......	......	360	410	1,430	520	360	225	310	1,430	410	410
16	......	......	360	410	1,100	520	360	265	740	2,720	360	360
17	......	......	225	980	1,100	410	310	265	465	1,770	360	360
18	......	......	225	740	860	360	310	265	360	980	360	310
19	......	225	310	630	800	410	310	265	920	2,380	360	630
20	......	225	225	575	740	410	265	310	685	1,240	360	520
21	......	225	225	410	740	410	265	360	520	2,900	575	410
22	......	195	225	410	685	360	265	410	465	1,360	1,170	360
23	......	195	225	410	685	360	310	310	360	920	685	360
24	......	195	225	410	685	360	265	265	310	740	630	360
25	......	195	195	410	685	360	265	265	310	630	575	360
26	......	195	195	410	685	360	265	265	260	575	465	310
27	......	195	195	410	740	360	265	310	260	575	410	465
28	......	195	195	360	575	360	265	310	260	520	360	980
29	......	195	225	360	......	310	265	265	225	410	360	630
30	......	195	920	360	......	310	265	685	1,170	520	360	465
31	......	......	465	360	......	310	......	465	......	410	310	......
1916-17.												
1	405	320	360	405	980	700	700	1,630	1,040	920	405	285
2	405	320	360	405	810	545	980	920	755	810	360	285
3	360	320	360	405	700	545	1,300	865	700	700	360	320
4	360	320	360	405	1,300	450	865	755	645	595	320	285
5	360	320	405	1,980	1,300	450	865	1,980	980	495	320	285
6	360	320	405	4,370	1,770	405	2,060	1,170	1,300	450	320	285
7	360	320	405	1,500	1,980	405	1,240	920	865	645	360	285
8	320	320	405	1,040	810	700	980	810	700	595	360	285
9	320	320	405	920	700	700	865	810	645	495	320	285
10	320	360	405	810	700	645	810	700	865	645	320	285
11	320	360	405	755	700	810	755	645	755	595	320	285
12	320	320	360	595	595	1,840	755	595	645	755	320	250
13	320	320	360	495	595	1,300	755	595	495	595	285	250
14	320	320	360	495	495	5,250	700	595	495	1,630	285	250
15	320	320	360	495	450	2,220	700	595	495	3,080	285	250
16	320	320	360	495	450	1,360	700	545	450	1,170	285	250
17	320	320	360	495	450	1,170	700	545	450	1,040	285	250
18	320	320	360	450	545	865	980	495	405	1,360	285	250
19	405	320	360	450	450	865	865	495	405	865	285	250
20	450	320	360	450	920	865	755	495	405	755	285	250
21	405	320	360	450	700	865	700	495	405	645	320	250
22	405	320	360	2,540	595	980	700	545	405	595	405	250
23	360	360	360	1,770	700	920	645	595	405	545	405	250
24	360	405	360	980	1,980	2,460	545	545	645	495	320	250
25	360	405	360	810	980	1,240	700	495	495	450	285	250
26	360	360	360	700	755	980	700	450	450	865	285	250
27	320	360	700	595	1,100	865	645	645	450	810	250	250
28	320	405	1,360	700	700	865	645	700	865	700	250	209
29	320	405	755	980	......	810	645	1,360	3,170	545	285	209
30	320	360	450	1,430	......	755	595	810	1,360	495	360	209
31	320	......	405	1,170	......	700	......	700	......	450	320	......

Monthly discharge of Mad River near Dayton, Ohio, for the years ending Sept. 30, 1915, and 1917.

[Drainage area, 652 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1914-15.					
November 19-30	225	195	202	0.310	0.12
December	920	195	353	.541	.62
January	3,260	265	562	.862	.99
February	4,810	575	1,540	2.36	2.46
March	1,170	310	514	.788	.91
April	465	265	297	.456	.51
May	685	225	291	.446	.51
June	1,170	225	435	.666	.74
July	4,700	410	1,210	1.86	2.14
August	1,170	310	469	.719	.83
September	2,220	265	599	.919	1.03
The period Nov. 19 to Sept. 30	4,810	195	604	.926	10.86
1916-17.					
October	450	320	350	0.537	0.62
November	405	320	339	.520	.58
December	1,360	360	430	.660	.76
January	4,370	405	953	1.46	1.68
February	1,980	450	865	1.33	1.38
March	5,250	405	1,080	1.66	1.91
April	2,060	545	828	1.27	1.42
May	1,980	450	758	1.16	1.34
June	3,170	405	738	1.13	1.26
July	3,080	450	800	1.23	1.42
August	405	250	318	.488	.56
September	320	209	260	.399	.45
The year	5,250	209	643	.986	13.38

BUCK CREEK AT SPRINGFIELD, OHIO.

LOCATION.—At Plum Street Bridge in Springfield, Clark County.

DRAINAGE AREA.—163 square miles.

RECORDS AVAILABLE.—July 15, 1914, to September 30, 1917.

GAGE.—Vertical staff in two sections; read by S. Van Bird, jr. Elevation of zero of gage above sea level, 908.2 feet.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge or by wading.

CHANNEL AND CONTROL.—Channel may shift slightly during floods.

EXTREMES OF STAGE.—Maximum daily stage recorded during year, 5.9 feet, January 5; minimum daily stage, 0.5 foot, September 27.

The flood of March-April, 1913, the highest known to have occurred at this station, reached a stage on March 25, represented by 12.3 feet, referred to gage datum.

ICE.—Stage-discharge relation affected by ice for short periods only, as the use of water for condensing purposes at points above the gage tends to keep the temperature above freezing.

ACCURACY.—Stage-discharge relation not permanent; probably not affected by ice. Rating curve for 1917 not definitely defined. Gage read daily to tenths. Records good.

COOPERATION.—Base data furnished by the Miami Conservancy District.

Discharge measurements of Buck Creek at Springfield, Ohio, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Mar. 12	G. N. Burrell	1.78	190
May 22	H. R. Daubenspeck	1.35	107
Aug. 8	G. N. Burrell	1.00	65.7

Daily gage height, in feet, of Buck Creek at Springfield, Ohio, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.0	0.8	0.9	1.1	1.5	1.3	1.4	1.8	1.6	1.8	0.9	0.7
2	1.0	.8	.9	1.3	1.3	1.4	2.0	1.5	1.6	1.7	1.0	.7
3	1.0	.8	.9	1.6	1.2	1.5	1.8	1.4	1.5	1.6	.9	.7
4	1.0	.8	.9	1.9	1.0	1.4	1.6	2.5	1.7	1.6	.8	.6
5	1.0	.8	1.0	5.9	.9	1.4	2.2	2.0	2.1	1.4	.8	.7
6	1.0	.8	.9	2.5	.9	1.3	2.5	1.9	2.0	1.3	.7	.7
7	1.0	.8	.9	2.1	.8	1.3	1.9	1.5	2.0	1.2	.9	.6
8	.9	.8	.8	1.9	.8	1.5	1.8	1.5	2.2	1.4	1.0	.7
9	.9	.8	.8	1.6	.8	1.4	1.8	1.4	1.9	1.3	1.0	.7
10	.9	.9	.8	1.5	.8	1.3	1.7	1.3	1.3	1.3	1.1	.7
11	.9	.9	.8	1.3	.8	2.5	1.5	1.3	1.3	1.3	.9	.8
12	.9	.8	.8	1.0	1.0	1.9	1.2	1.3	1.4	1.4	.9	.6
13	.9	.8	.8	1.0	1.0	2.4	1.2	1.3	1.2	1.5	.8	.7
14	.9	.8	.8	.9	1.0	3.5	1.2	1.3	1.5	1.3	.8	.6
15	.9	.8	.8	.9	1.1	2.0	1.2	1.2	1.3	4.2	.7	.6
16	.9	.8	.8	.9	1.2	1.8	1.2	1.2	1.3	1.5	.9	.6
17	.9	.8	.7	.9	1.1	1.9	1.2	1.2	1.3	1.9	.8	.7
18	.9	.8	.7	1.0	1.1	1.7	2.4	1.3	1.3	2.0	.8	.6
19	1.1	.8	.8	1.0	1.3	1.6	1.6	1.2	1.3	1.5	.7	.6
20	1.2	.8	.8	1.0	1.7	1.5	1.4	1.2	1.3	1.4	.7	.7
21	1.1	.8	.8	1.5	1.2	1.8	1.4	1.3	1.3	1.2	.6	.7
22	1.0	.8	.8	3.8	1.5	1.8	1.3	1.4	1.4	1.1	.7	.6
23	.9	1.4	.8	2.0	3.5	1.9	1.2	1.4	3.0	1.0	.8	.6
24	.9	1.2	.8	1.7	1.8	2.5	2.0	1.6	1.5	.9	.7	.6
25	.8	1.0	.8	1.5	1.5	1.9	1.5	1.4	1.3	1.2	.6	.7
26	.8	.9	1.0	1.2	1.5	1.7	1.4	1.7	1.4	1.4	.9	.6
27	.8	.8	2.2	1.2	1.4	1.9	1.5	1.9	2.5	1.2	.8	.5
28	.8	1.0	2.0	1.8	1.3	1.4	1.6	3.0	2.2	1.1	.8	.6
29	.8	1.2	1.6	2.2	......	1.2	1.4	2.0	2.1	1.1	.8	.6
30	.8	1.0	1.3	2.0	......	1.2	1.4	1.8	2.0	1.0	.8	.6
31	.8	......	1.1	1.8	......	1.1	......	1.6	......	.9	.8	......

TWIN CREEK NEAR GERMANTOWN, OHIO.

Location.—At covered highway bridge in NE. ¼ sec. 14, T. 3 N., R. 4 E., about 1 mile west of Germantown, Montgomery County, and about 2 miles above mouth of Little Twin Creek, which enters from left.

Drainage area.—272 square miles.

Records available.—April 12, 1914, to September 30, 1917.

Gage.—Vertical staff in two sections; read by Thomas Stettler. Sea-level elevation of zero of gage, 712.73 feet.

Discharge measurements.—Made from downstream side of the bridge or by wading about 200 feet above gage. The bridge makes an angle of about 45° with the direction of the current. Flood measurements can be made at the highway bridge about half a mile below the gage.

Channel and control.—Channel shifts slightly during floods.

Extremes of stage.—Maximum daily stage recorded during year, 7.1 feet, March 14; minimum daily stage, 0.8 foot, September 18-30. The flood of March–April, 1913, the highest known to have occurred at this station, reached a stage on March 25 of 18.3 feet, referred to gage datum.

Ice.—Stage-discharge relation affected by ice during severe winters.

ACCURACY.—Stage-discharge relation not permanent; probably not affected by ice. Rating curve not developed. Measurements indicate considerable change in control. Gage read daily to tenths. Records good.

COOPERATION.—Station maintained and records furnished by the Miami Conservancy District.

Discharge measurements of Twin Creek near Germantown, Ohio, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 31	H. R. Daubenspeck..	1.25	23.2	May 23	H. R. Daubenspeck..	2.62	459
Mar. 27	G. N. Burrell........	2.30	306	July 26	G. N. Burrell........	2.08	231
Apr. 10	H. R. Daubenspeck..	2.20	308				

Daily gage height, in feet, of Twin Creek near Germantown, Ohio, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.4	1.2	1.4	2.4	3.5	2.0	2.0	2.1	2.8	1.9	1.3	1.2
2	1.3	1.2	1.3	2.3	2.5	1.9	4.3	2.5	2.3	1.9	1.2	1.3
3	1.3	1.2	1.3	2.3	2.4	1.9	3.4	2.1	2.6	1.9	1.1	1.7
4	1.3	1.2	1.3	2.3	2.0	1.8	2.7	2.1	2.2	1.7	1.1	1.4
5	1.2	1.2	1.5	5.5	1.9	1.8	2.5	4.3	2.6	1.6	1.1	1.2
6	1.2	1.2	1.5	6.3	1.9	1.7	4.0	2.8	4.5	1.6	1.1	1.1
7	1.2	1.2	1.5	3.8	1.9	1.8	3.0	2.7	3.2	1.6	1.1	1.0
8	1.2	1.2	1.5	3.1	1.9	2.0	2.5	2.4	2.6	1.9	1.1	1.1
9	1.2	1.2	1.6	2.8	1.9	2.6	2.3	2.2	2.3	1.7	1.1	1.1
10	1.2	1.3	1.6	2.8	1.9	2.7	2.2	2.2	3.2	1.6	1.0	1.1
11	1.2	1.3	1.6	2.5	1.6	2.6	2.1	2.1	2.5	1.6	1.0	1.1
12	1.2	1.3	1.6	2.2	1.6	6.4	2.1	2.1	2.2	1.6	1.0	1.0
13	1.2	1.3	1.5	2.1	1.7	3.7	2.1	2.0	2.1	1.5	1.0	1.0
14	1.2	1.3	1.3	1.9	1.6	7.1	2.0	1.9	2.0	3.7	1.0	1.0
15	1.2	1.3	1.4	1.9	1.6	4.0	1.9	1.9	2.0	2.0	1.0	.9
16	1.2	1.3	1.4	1.9	1.7	3.2	1.9	1.8	1.9	1.8	1.0	.9
17	1.2	1.3	1.4	1.8	1.7	3.0	1.9	1.8	1.8	1.9	.9	.9
18	1.2	1.3	1.3	1.8	1.7	2.6	1.8	1.8	1.8	2.0	.9	.8
19	1.3	1.3	1.3	1.8	1.7	2.3	2.1	1.7	1.8	1.8	.9	.8
20	1.3	1.3	1.3	1.7	2.2	2.2	2.0	1.7	1.7	1.7	.9	.8
21	1.5	1.2	1.4	1.8	1.9	2.2	2.0	1.7	1.7	1.6	.9	.8
22	1.6	1.2	1.3	6.7	1.8	2.8	1.9	1.7	1.7	1.5	2.3	.8
23	1.5	1.3	1.3	3.8	1.7	2.4	1.8	1.8	1.6	1.4	2.1	.8
24	1.4	1.5	1.3	2.9	3.8	4.4	1.8	2.1	1.6	1.4	1.7	.8
25	1.4	1.5	1.3	2.4	2.3	3.1	1.9	1.9	1.6	1.4	1.7	.8
26	1.4	1.4	1.3	2.1	2.1	2.6	1.9	1.8	1.6	2.9	1.4	.8
27	1.3	1.4	3.1	2.1	2.1	2.4	1.9	3.7	1.6	2.1	1.2	.8
28	1.3	1.3	3.7	2.1	2.1	2.2	1.9	2.7	2.3	1.7	1.1	.8
29	1.3	1.4	2.5	2.2	......	2.1	2.0	3.9	2.7	1.5	1.1	.8
30	1.3	1.4	2.3	3.7	......	2.0	1.9	2.8	2.7	1.4	1.2	.8
31	1.2	......	2.3	3.2	......	2.0	......	2.8	......	1.3	1.3	......

FOURMILE CREEK NEAR SEVENMILE, OHIO.

LOCATION.—In NW. ¼ sec. 7, T. 2 N., R. 3 E. first principal meridian, at steel-truss highway bridge about 2 miles southwest of Sevenmile, Butler County, and about 5 miles above junction with Miami River, near Hamilton.

DRAINAGE AREA.—178 square miles.

RECORDS AVAILABLE.—November 17, 1914, to September 30, 1917.

GAGE.—Vertical staff in two sections; read by W. B. Eaton. The lower section is on downstream side of bridge pier; upper section is on tree on right bank just below bridge. Sea-level elevation of zero of gage, 618.69 feet.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge at gage or by wading 700 feet above gage.

CHANNEL AND CONTROL.—Stream bed is composed of gravel; shifts considerably during floods.

EXTREMES OF STAGE.—Maximum daily stage recorded during year, 6.5 feet June 5; minimum daily stage, 0.5 foot October 11–15, 17. Maximum stage recorded, 18 feet, March 25, 1913.

ICE.—Stage-discharge relation may be affected by ice jams at times.

ACCURACY.—Stage-discharge relation not permanent; probably not seriously affected by ice during the year. Rating curve not developed. Recent measurements indicate some change in control. Gage read to tenths daily. Records good.

COOPERATION.—Gage-height recorded and results of discharge measurements furnished by the Miami Conservancy District.

Discharge measurements of Fourmile Creek near Sevenmile, Ohio., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 31	G. N. Burrell........	0.7	2.1	June 5	H. R. Daubenspeck..	4.75	2,380
Mar. 13	H. R. Daubenspeck..	7.4	5,350	Aug. 15	G. N. Burrell........	1.2	6.5
14	.....do...............	4.25	1,540				

Daily gage height, in feet, of Fourmile Creek near Sevenmile, Ohio, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	0.9	0.7	1.0	1.4	2.6	2.7	3.5	2.6	2.4	1.8	1.8	1.1
2	.8	.7	1.0	1.4	2.4	2.7	3.3	2.0	2.0	1.7	1.8	1.1
3	.6	.7	1.0	1.7	2.4	2.7	3.0	1.9	2.0	1.7	1.8	1.1
4	.6	.7	.9	1.6	1.7	1.9	2.8	1.9	3.3	1.7	1.8	1.1
5	.6	.7	.9	5.0	1.7	1.5	2.8	1.7	6.5	1.7	1.7	1.1
6	.6	.7	1.1	3.4	1.7	1.5	2.6	1.4	4.8	1.7	1.7	1.1
7	.6	.7	1.1	2.8	1.7	1.5	2.5	1.3	2.9	1.7	1.7	1.1
8	.6	.7	1.1	2.4	1.7	1.5	2.0	1.8	2.6	1.8	1.4	1.2
9	.6	.7	1.4	1.6	1.5	1.6	1.8	1.8	2.5	1.8	1.3	1.1
10	.6	.7	1.1	1.6	1.5	1.5	1.8	1.8	2.0	2.0	1.1	1.0
11	.5	.7	1.1	1.4	1.5	1.5	1.6	1.8	2.0	2.0	1.1	1.0
12	.5	.7	1.1	1.4	1.5	4.0	1.7	1.8	1.8	2.1	1.1	1.0
13	.5	.7	1.1	1.3	1.5	5.0	1.8	1.8	1.8	2.2	1.1	.9
14	.5	.7	1.1	1.4	1.9	5.4	1.8	1.7	1.8	2.2	1.1	.9
15	.5	.7	1.1	1.6	2.1	3.2	1.8	1.7	1.8	2.2	1.1	.9
16	.9	.7	1.1	1.6	2.5	2.9	1.8	1.6	1.8	2.3	1.2	.9
17	.5	.7	1.0	1.6	2.5	2.8	1.8	1.6	1.8	2.3	1.2	.9
18	1.0	.7	1.0	1.6	2.5	2.8	1.8	1.8	1.8	2.3	1.2	.9
19	1.1	.7	.9	1.6	2.6	2.8	1.8	1.8	1.8	2.3	1.2	.9
20	1.1	.7	.9	1.6	2.6	2.8	1.8	1.8	1.8	2.4	1.8	.9
21	1.1	.7	1.1	1.6	2.6	2.8	1.9	1.8	1.8	2.4	1.7	.9
22	1.1	.7	1.1	5.0	2.6	2.8	1.9	1.8	1.8	2.2	1.4	.9
23	.9	1.4	1.1	2.4	3.0	2.8	1.9	1.8	1.8	1.8	1.1	.9
24	.9	1.1	1.1	2.0	3.0	3.0	2.0	1.8	1.8	1.8	1.1	.9
25	.9	1.1	1.1	2.0	2.9	2.8	1.6	1.8	1.8	1.6	1.1	.9
26	.7	1.1	1.4	2.1	2.9	2.8	1.7	2.0	2.0	1.6	1.2	.9
27	.7	1.1	3.2	2.4	2.8	2.7	2.0	1.9	2.0	1.7	1.2	.9
28	.7	1.1	2.9	2.4	2.9	2.4	2.2	2.3	1.8	1.8	1.4	.9
29	.7	1.1	2.4	3.6	....	2.1	1.9	2.3	1.8	1.8	1.4	.9
30	.7	1.1	1.8	3.0	....	2.0	3.0	2.4	1.8	1.8	1.4	.9
31	.7	....	1.6	2.6	....	3.5	....	3.0	....	1.8	1.3	....

SEVENMILE CREEK AT SEVENMILE, OHIO.

LOCATION.—On line between sec. 5, T. 2 N., R. 3 E., and sec. 32, T. 3 N., R. 3 E. first principal meridian, at covered highway bridge about half a mile west of Sevenmile, Butler County, and about 1 mile above junction with Fourmile Creek.

DRAINAGE AREA.—128 square miles.

RECORDS AVAILABLE.—November 17, 1914, to September 30, 1917.

GAGE.—Vertical staff on downstream side of west abutment; read by H. L. Kumler. Sea-level elevation of zero of gage, 623.1 feet.

DISCHARGE MEASUREMENTS.—Made from bridge at gage or by wading just above bridge.

CHANNEL AND CONTROL.—Stream bed at the gage is for the most part limestone bedrock in horizontal layers; although some gravel occurs along the east side, the section is practically permanent.

EXTREMES OF STAGE.—Maximum daily stage recorded during year, 7.8 feet January 5; minimum daily stage, 1.4 feet August 19–20. Maximum stage recorded, 17 feet, March 25, 1913.

ICE.—Stream is seldom covered with ice on account of the high velocities, but stage-discharge relation is sometimes affected by ice jams.

ACCURACY.—Stage-discharge relation practically permanent; not seriously affected by ice during the year. Rating curve not developed. Gage read daily to tenths. Records good.

COOPERATION.—Gage-height record and results of discharge measurements furnished by the Miami Conservancy District.

Discharge measurements of Sevenmile Creek at Sevenmile, Ohio, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 31	G. N. Burrell........	1.80	4.4	June 5	H. R. Daubenspeck..	5.9	2,290
Mar. 14	H. R. Daubenspeck..	4.8	1,300	Aug. 15	G. N. Burrell........	1.80	11.2

Daily gage height, in feet, of Sevenmile Creek at Sevenmile, Ohio, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.8	1.8	1.9	2.2	3.2	2.2	2.7	2.5	2.6	2.4	2.0	2.0
2	1.8	1.8	1.9	2.2	2.6	2.2	3.9	2.4	2.7	2.6	2.0	2.0
3	1.8	1.8	1.8	2.2	2.4	2.1	3.2	2.3	2.6	2.8	2.0	2.0
4	1.8	1.8	1.8	2.2	2.7	....	2.9	2.3	2.8	2.4	1.9	1.9
5	1.8	1.7	1.9	7.8	4.4	....	4.2	3.5	7.2	2.3	1.9	1.8
6	1.7	1.7	1.9	3.9	4.5	....	3.7	2.6	3.8	2.5	1.9	1.8
7	1.7	1.7	1.9	3.3	4.4	....	3.0	2.6	3.3	2.3	1.8	1.8
8	1.8	1.7	1.9	3.0	3.5	....	2.9	2.6	2.9	2.3	1.8	2.0
9	1.8	1.8	1.9	2.8	2.5	....	2.8	2.6	2.5	2.2	1.7	1.9
10	1.8	1.8	1.9	2.7	2.2	....	2.7	2.5	3.3	2.2	1.7	1.8
11	1.8	1.7	1.9	2.6	2.3	....	2.7	2.5	3.0	2.2	1.7	1.7
12	1.8	1.7	1.9	2.5	2.3	....	2.6	2.4	2.5	2.0	1.7	1.7
13	1.8	1.8	1.9	2.5	2.8	....	2.5	2.3	2.5	2.0	1.7	1.6
14	1.8	1.8	2.0	3.2	2.4	....	2.5	2.3	2.7	3.8	1.6	1.6
15	1.8	1.8	2.0	3.4	2.2	....	2.5	2.2	2.6	3.0	1.6	1.6
16	1.8	1.8	2.0	3.2	2.2	....	2.4	2.2	2.4	2.4	1.6	1.9
17	1.8	1.8	2.0	3.3	2.2	....	2.4	2.2	2.4	4.8	1.5	1.8
18	1.7	1.8	2.0	3.1	2.3	3.1	2.3	2.2	2.3	2.7	1.5	1.8
19	1.7	1.8	2.0	3.2	2.3	3.1	2.4	2.2	2.3	2.5	1.4	1.8
20	1.9	1.8	2.0	2.9	2.6	3.0	2.4	2.2	2.3	2.2	1.4	1.8
21	2.0	1.8	2.0	2.3	2.3	2.8	2.4	2.2	2.2	2.2	1.5	1.8
22	1.9	1.8	2.0	4.9	2.2	2.7	2.4	2.2	2.2	2.2	1.5	1.8
23	1.9	1.9	2.0	3.2	2.4	2.8	2.4	2.3	2.2	2.2	2.2	1.8
24	1.9	1.9	1.9	3.9	3.1	3.5	2.4	2.3	2.2	2.2	2.1	1.8
25	1.8	1.9	1.9	3.7	2.2	3.1	2.3	2.5	2.2	2.1	2.1	1.7
26	1.8	1.8	1.9	2.5	2.2	3.1	2.3	2.5	2.0	2.1	2.1	1.7
27	1.8	1.8	4.2	2.4	2.2	2.8	2.3	2.6	2.0	2.0	2.0	1.7
28	1.8	1.9	2.9	2.7	2.2	2.7	2.6	3.1	2.8	2.0	2.0	1.7
29	1.8	1.9	2.4	3.2	....	2.7	2.5	3.4	2.6	2.0	2.2	1.7
30	1.8	1.9	2.2	3.1	....	2.7	2.3	2.6	2.3	2.0	2.1	1.7
31	1.8	....	2.2	3.1	....	2.6	....	2.4	....	2.0	2.1	....

NOTE.—No readings Mar. 4–17.

WHITEWATER RIVER AT BROOKVILLE, IND.

LOCATION.—At two-span steel highway bridge about three-fourths mile south of Brookville, Franklin County, and about 2,000 feet below junction of east and west forks of Whitewater River.

DRAINAGE AREA.—1,180 square miles.

RECORDS AVAILABLE.—June 8, 1915, to September 30, 1917.

GAGE.—Chain gage fastened to downstream side of bridge; read by H. Koerner.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Control about 500 feet below gage is probably permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.7 feet March 13 (discharge, about 39,000 second-feet); minimum stage, 1.05 feet morning February 14 (discharge, 164 second-feet).

REGULATION.—Flow regulated to some extent by the Thompson-Norris strawboard mill at Brookville. Water is diverted from the west fork about 10 miles above station and flows down the old Whitewater Canal to the mill and is returned to the river a few hundred feet above junction of the east and west forks.

ACCURACY.—Stage-discharge relation practically permanent; probably not affected by ice during year. Rating curve well-defined between 200 and 12,500 second-feet; beyond these limits curve is an extension. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage heights to rating table. Records good.

COOPERATION.—Base data furnished by United States Army Engineers.

Daily discharge, in second-feet, of Whitewater River at Brookville, Ind., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	228	199	242	570	1,340	835	788	2,500	1,540	650	242	208
2	228	199	242	570	740	740	5,430	1,840	2,680	695	242	199
3	228	199	255	650	462	650	3,620	1,280	1,540	495	228	1,400
4	218	190	255	610	352	695	2,320	1,100	935	375	228	272
5	208	199	255	19,900	228	740	4,960	3,620	15,300	352	218	228
6	208	199	255	13,400	532	430	7,550	2,320	4,050	352	228	208
7	199	199	288	3,420	695	1,100	3,620	1,690	3,040	402	255	242
8	199	199	308	2,500	740	1,840	2,320	1,400	1,840	1,160	218	4,730
9	199	199	462	2,000	532	1,280	2,000	1,280	4,730	695	218	570
10	218	208	288	1,690	430	1,160	1,690	1,840	3,420	495	228	328
11	242	218	272	1,280	375	2,680	1,480	308	2,320	462	218	255
12	228	208	308	835	190	11,100	1,280	835	1,480	462	218	218
13	242	218	288	935	190	27,900	1,160	835	1,160	402	218	218
14	218	228	255	788	164	19,900	990	695	1,040	2,500	208	218
15	218	228	255	610	172	4,960	935	650	885	990	199	208
16	208	228	255	695	375	3,420	885	610	788	740	199	204
17	208	228	255	650	352	2,860	788	532	650	1,340	199	199
18	208	218	242	462	532	3,040	788	495	610	935	208	194
19	218	228	255	570	695	1,760	835	495	570	610	199	190
20	255	228	242	570	695	1,540	835	462	462	462	272	199
21	308	218	272	695	695	1,620	835	462	430	430	228	218
22	242	228	242	9,420	610	2,320	740	532	430	352	328	218
23	228	242	228	2,860	3,230	3,830	650	1,040	430	328	352	218
24	228	255	228	1,690	2,860	4,050	650	570	430	375	375	199
25	228	242	242	1,340	1,340	2,320	740	495	402	352	255	199
26	228	255	228	1,220	1,040	1,690	788	462	375	402	242	190
27	218	255	6,180	935	1,040	1,540	788	1,100	495	430	228	190
28	208	255	3,830	1,160	935	1,230	990	4,270	1,840	352	218	208
29	208	242	352	2,160	......	1,160	1,040	2,500	1,480	288	208	199
30	199	255	650	2,000	......	1,040	1,100	1,280	990	272	218	208
31	199	......	570	2,500	......	990	......	1,220	......	255	218	......

Monthly discharge of Whitewater River at Brookville, Ind., for the year ending Sept. 30, 1917.

[Drainage area, 1,180 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	308	199	222	0.188	0.22
November	255	190	222	.188	.21
December	6,180	228	597	.506	.58
January	19,900	462	2,540	2.15	2.48
February	3,230	164	769	.652	.68
March	27,900	430	3,560	3.02	3.48
April	7,550	650	1,750	1.48	1.65
May	4,270	308	1,250	1.06	1.22
June	15,300	375	1,880	1.59	1.77
July	2,500	255	594	.503	.58
August	375	199	236	.200	.22
September	4,730	190	418	.354	.40
The year	27,900	164	1,170	.992	13.49

KENTUCKY RIVER BASIN.

DIX RIVER NEAR BURGIN, KY.

LOCATION.—At covered wooden highway bridge on Burgin and Buena Vista pike, 3¾ miles due east of Burgin, Mercer County. Kennedy's mill is one-fourth mile above station.

DRAINAGE AREA.—395 square miles (86 per cent measured on topographic maps and 14 per cent on map of Kentucky, compiled by United States Geological Survey, scale 1:500,000).

RECORDS AVAILABLE.—July 2, 1910, to July 16, 1911; October 1, 1911, to September 30, 1917.

GAGE.—Staff gage attached to right upstream wing wall of bridge near face of abutment; read twice daily by Frank Martin. Soundings taken at the measuring section indicate that the zero of the gage as replaced by the observer on February 15, 1913, is approximately 0.2 foot below zero of gage installed when station was established. Gage readings subsequent to February 15, 1913, refer to a datum which is about 0.2 foot below datum of original gage.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge, from a boat, or by wading.

CHANNEL AND CONTROL.—Probably permanent except during extreme floods. At stages above low water the growth of foliage on trees and brush at the control may affect the stage-discharge relation to a small extent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 29.0 feet about 3 a. m. January 22 (discharge, 27,500 second-feet); minimum stage, 2.80 feet July 11–14 (discharge, 2.5 second-feet).

Maximum stage about 30 feet; date unknown.

ICE.—Ice forms only during severe winters.

ACCURACY.—Stage-discharge relation practically permanent; not affected by ice during the year. Rating curve well defined up to 455 second-feet and fairly well defined between 455 and 12,000 second-feet; extended above 12,000 second-feet. Gage read twice daily to quarter tenths. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

COOPERATION.—Station maintained in cooperation with Kentucky State Geological Survey, J. B. Hoeing, State geologist.

Discharge measurements of Dix River near Burgin, Ky., during the year ending Sept. 30, 1917.

[Made by Jones and Sellier.]

Date.		Gage height.	Dis-charge.
		Feet.	*Sec.-ft.*
Jan. 23	....	11.68	4,950
July 19	....	2.86	3.4

Daily discharge, in second-feet, of Dix River near Burgin, Ky., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	16	22	35	455	925	6,510	345	222	60	16	44	35
2	34	21	32	455	1,270	3,040	4,830	190	82	14	38	34
3	12	20	31	2,090	875	6,990	2,860	142	1,150	12	36	50
4	11	18	31	11,200	649	4,400	1,270	116	389	9.6	35	108
5	10	18	34	12,400	438	2,770	925	97	244	9.2	32	92
6	9.2	16	32	6,270	318	1,940	1,870	88	160	8.0	29	75
7	8.0	15	32	2,420	345	2,090	1,340	94	133	8.0	25	58
8	6.4	15	36	1,400	292	6,510	875	88	256	8.0	24	48
9	10	15	42	925	268	3,310	825	77	180	6.8	21	41
10	9.2	12	42	735	233	1,800	691	72	691	4.6	19	34
11	8.0	12	39	529	233	1,210	529	72	491	2.5	16	32
12	7.6	11	34	389	211	1,270	405	71	331	2.5	13	27
13	6.8	11	36	331	142	2,170	421	66	222	2.5	11	20
14	6.0	10	39	280	142	1,660	438	61	160	2.5	10	18
15	6.0	9.2	38	280	190	1,530	405	56	124	3.2	9.2	16
16	7.6	9.2	35	359	1,340	925	318	51	100	3.4	10	13
17	10	9.2	32	374	975	3,220	268	49	86	3.6	11	12
18	15	9.2	35	359	735	3,700	233	45	70	3.9	10	10
19	46	10	32	345	825	1,400	211	41	58	4.2	14	7.6
20	256	10	34	405	3,900	925	190	38	50	16	15	6.0
21	568	12	36	1,400	2,770	780	160	35	44	29	16	7.6
22	200	13	100	22,300	1,270	925	133	34	38	88	21	6.0
23	73	12	649	7,870	975	1,030	133	34	35	82	133	5.3
24	85	17	491	1,870	4,300	10,300	116	31	29	62	649	5.3
25	62	29	438	1,400	2,250	2,950	116	29	29	48	875	5.3
26	48	31	491	1,030	1,270	1,400	97	25	24	48	222	3.2
27	41	34	691	735	825	925	85	24	20	280	108	4.2
28	36	54	4,720	649	7,230	1,030	78	32	18	438	85	11
29	32	48	3,130	925	......	735	100	82	19	222	66	22
30	29	41	1,340	825	......	529	280	66	16	70	44	108
31	25	......	649	649	......	405	......	55	......	50	41	......

Monthly discharge of Dix River near Burgin, Ky., for the year ending Sept. 30, 1917.

[Drainage area, 395 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	568	6	54.6	0.138	0.16
November	54	9.2	18.8	.048	.05
December	4,720	31	433	1.10	1.27
January	22,300	280	2,630	6.66	7.68
February	7,230	142	1,260	3.19	3.32
March	10,300	405	2,530	6.41	7.39
April	4,830	78	685	1.73	1.93
May	222	24	70.4	.178	.20
June	1,150	16	177	.448	.50
July	438	2.5	50.2	.127	.15
August	875	9.2	86.5	.219	.25
September	108	3.2	30.5	.077	.09
The year	22,300	2.5	669	1.69	22.99

ELKHORN CREEK AT FORKS OF ELKHORN, KY.

LOCATION.—At footbridge at Forks of Elkhorn, Franklin County, three-fourths mile below forks of stream and 5 miles northeast of Frankfort.

DRAINAGE AREA.—415 square miles (measured by United States Engineer Corps).

RECORDS AVAILABLE.—April 26, 1915, to September 30, 1917.

GAGE.—Vertical staff in two sections on left bank; section reading 0 to 5 feet attached to elm tree 40 feet below bridge, other section attached to sycamore tree about 20 feet below bridge; read by R. S. Estes.

DISCHARGE MEASUREMENTS.—Made from footbridge.

CHANNEL AND CONTROL.—Bed of stream loose and bed rock; probably permanent. Control short distance below gage, composed of solid rock and boulders; permanent.

ICE.—Stage-discharge relation probably not affected by ice except during severe winters.

ACCURACY.—Stage-discharge relation probably permanent; not affected by ice during year. Rating curve well defined, 65 to 18,000 second-feet and fairly well defined at other stages. Gage read twice daily to tenths. Daily discharge ascertained by applying mean gage readings to rating table. Results good.

COOPERATION.—Base data furnished by United States Engineer Corps.

Discharge measurements of Elkhorn Creek at Forks of Elkhorn, Ky., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec-ft.*			*Feet.*	*Sec.-ft.*
Jan. 3	C. J. Thiebaud	6.6	4,260	May 19	C. J. Thiebaud	0.55	78.2
22	.....do	11.75	13,500	July 20	B. E. Jones	.96	140
22	.....do	11.8	12,700	31	L. Scofield	.6	78.9
Apr. 3	.....do	5.92	3,630				

Daily discharge, in second-feet, of Elkhorn Creek at Forks of Elkhorn, Ky., for the years ending Sept. 30, 1915–1917.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1915.						1915.					
1	135	482	180	180	335	16	204	305	390	320	254
2	135	1,710	196	180	320	17	196	278	335	1,140	455
3	180	1,540	222	222	305	18	196	278	305	1,880	835
4	180	1,060	320	910	292	19	180	243	278	910	730
5	164	1,540	410	800	1,540	20	180	222	243	910	482
6	164	662	352	662	2,420	21	180	213	204	910	320
7	222	1,380	320	455	1,620	22	455	213	180	1,380	266
8	730	1,300	1,380	320	1,140	23	1,220	196	180	948	254
9	432	1,140	2,600	243	730	24	1,060	188	180	835	254
10	292	835	2,330	213	482	25	835	180	180	765	254
11	292	510	1,710	213	390	26	630	180	180	510	254
12	266	390	1,060	213	335	27	630	180	180	370	254
13	232	335	695	213	335	28	750	180	180	335	254
14	213	335	540	213	305	29	872	180	180	335	254
15	213	335	455	910	278	30	695	172	180	455	254
						31	540	....	180	390	....

Daily discharge in second-feet, of Elkhorn Creek at Forks of Elkhorn, Ky., for the years ending Sept. 30, 1915–1917—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915–16.												
1	2,420	213	335	2,150	4,620	662	730	196	135	172	135	109
2	2,700	213	335	2,060	3,390	570	600	196	135	149	135	109
3	1,970	213	335	1,800	2,240	570	482	204	135	142	135	109
4	1,140	213	335	1,460	1,540	482	390	278	135	128	135	109
5	765	213	335	1,380	1,220	410	320	243	135	122	135	109
6	540	213	335	1,620	1,060	370	266	213	278	122	135	109
7	432	213	335	1,380	872	1,710	232	213	600	122	122	109
8	352	213	335	910	730	1,620	232	213	305	122	122	109
9	335	213	335	910	600	1,220	266	204	204	122	109	109
10	335	213	335	910	482	835	305	180	204	122	109	109
11	305	213	335	2,420	455	600	254	180	232	122	135	109
12	278	213	352	6,280	510	482	213	180	335	122	135	109
13	254	213	390	8,730	3,820	432	213	172	254	122	122	109
14	232	335	410	4,260	3,180	370	213	142	204	188	335	109
15	213	1,460	410	2,600	2,060	1,540	213	116	254	180	1,380	109
16	213	1,710	1,380	2,060	1,710	910	213	109	266	142	540	109
17	213	1,140	12,700	1,380	1,710	910	213	109	305	135	232	109
18	213	948	13,200	910	1,620	835	213	109	243	135	135	109
19	222	3,080	6,000	662	1,220	730	213	109	5,240	2,420	122	109
20	232	2,980	3,600	540	1,060	630	213	109	4,040	765	122	109
21	213	1,880	2,420	432	765	570	213	109	1,880	695	109	109
22	213	1,300	1,620	1,540	600	510	213	109	1,140	482	188	109
23	213	985	1,300	1,380	540	455	213	109	695	390	135	109
24	213	800	948	1,060	948	390	213	109	540	204	135	109
25	213	662	2,600	1,060	1,800	335	213	109	410	164	122	109
26	213	540	1,880	872	1,620	410	213	109	305	213	122	109
27	213	432	1,540	730	1,220	1,620	213	109	278	164	109	109
28	213	410	1,710	600	872	1,620	196	109	266	164	109	116
29	213	370	4,500	1,710	800	1,380	196	109	222	142	109	149
30	213	335	4,500	6,420	....	1,060	196	135	188	135	109	116
31	213	....	2,790	5,480	....	872	....	135	....	135	109	....
1916–17.												
1	109	109	109	695	630	630	570	164	410	66	86	57
2	109	109	109	630	630	1,140	7,020	164	695	66	76	49
3	109	109	109	5,240	570	1,460	3,920	164	455	66	76	49
4	109	109	109	2,790	410	2,150	2,240	164	305	66	76	49
5	109	109	1,380	3,820	335	2,150	2,600	164	278	66	66	49
6	109	109	305	3,390	335	1,620	4,740	135	232	66	62	49
7	109	109	232	2,600	335	1,460	2,980	135	455	66	57	49
8	109	109	196	1,460	254	2,880	570	135	1,460	66	57	92
9	109	109	196	835	180	4,860	1,540	135	8,550	66	57	116
10	109	109	164	765	164	4,040	1,220	135	2,600	66	57	86
11	109	109	164	570	164	4,150	765	135	1,380	66	57	62
12	109	109	135	510	164	5,870	570	135	630	66	57	57
13	109	109	135	510	164	4,620	370	135	410	66	53	57
14	109	109	135	510	164	5,240	335	135	455	66	49	57
15	109	109	135	510	164	3,080	278	135	305	66	49	57
16	109	109	135	510	164	2,240	278	135	254	66	49	49
17	109	109	135	510	164	1,710	278	135	180	66	49	49
18	109	109	135	455	232	1,300	278	135	135	66	49	49
19	164	109	135	278	370	835	232	103	135	66	49	49
20	128	109	135	196	335	630	213	76	135	86	49	49
21	122	109	135	2,330	335	3,600	180	76	135	109	49	49
22	109	109	135	13,400	335	2,330	135	81	135	86	49	49
23	109	109	135	6,720	570	2,150	135	109	135	76	49	49
24	109	109	232	2,980	910	3,390	135	86	109	66	49	49
25	109	109	410	2,060	570	2,420	135	86	109	254	49	49
26	109	109	765	1,380	370	1,460	135	86	97	305	49	49
27	109	109	6,570	910	335	1,620	135	5,360	86	180	49	49
28	109	109	4,500	835	370	1,060	135	5,360	86	122	49	49
29	109	109	2,980	765	....	695	135	2,150	76	86	49	49
30	109	109	1,710	765	....	455	164	765	66	66	66	49
31	109	....	1,060	630	....	305	....	455	....	76	62	....

Monthly discharge of Elkhorn Creek at Forks of Elkhorn, Ky., for the years ending Sept. 30, 1915–1917.

[Drainage area, 415 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1915.					
May	1,220	135	409	0.986	1.14
June	1,710	172	559	1.35	1.51
July	2,600	180	527	1.27	1.46
August	1,880	180	592	1.43	1.65
September	2,420	254	540	1.30	1.45
1915–16.					
October	2,700	213	507	1.22	1.41
November	3,080	213	738	1.78	1.99
December	13,200	335	2,190	5.28	6.09
January	8,730	432	2,120	5.11	5.89
February	4,620	455	1,490	3.59	3.87
March	1,710	335	810	1.95	2.25
April	730	196	269	.648	.72
May	278	109	152	.366	.42
June	5,240	135	652	1.57	1.75
July	2,420	122	276	.665	.77
August	1,380	109	190	.458	.53
September	149	109	111	.267	.30
The year	13,200	109	792	1.91	25.99
1916–17.					
October	164	109	112	0.270	0.31
November	109	109	109	.263	.29
December	6,570	109	739	1.78	2.05
January	13,400	196	1,920	4.63	5.34
February	910	164	347	.836	.87
March	5,870	305	2,310	5.57	6.42
April	7,020	135	1,080	2.60	2.90
May	5,360	76	560	1.35	1.56
June	8,550	66	683	1.65	1.84
July	305	66	89.2	.215	.25
August	86	49	56.4	.136	.16
September	116	49	55.7	.134	.15
The year	13,400	49	677	1.63	22.14

EAGLE CREEK AT GLENCOE, KY.

LOCATION.—At county highway bridge half a mile south of Glencoe, Gallatin County,

DRAINAGE AREA.—445 square miles (United States Engineer Corps).

RECORDS AVAILABLE.—April 29, 1915, to September 30, 1917.

GAGE.—Vertical staff attached to upstream side of first pier from left abutment of bridge; read by Anna Connelly.

DISCHARGE MEASUREMENTS.—Made from bridge.

CHANNEL AND CONTROL.—Bed of stream sand and loose stone; probably permanent. Small island covered with trees about 250 feet below bridge. Point of control not determined.

ICE.—Stage-discharge relation probably not affected by ice except in very cold winters.

ACCURACY.—Stage-discharge relation probably permanent; not affected by ice during year. Rating curve well defined between 50 and 15,000 second-feet, extended beyond these limits. Gage read twice daily to tenths. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

COOPERATION.—Base data furnished by United States Engineer Corps.

The following discharge measurement was made by C. J. Thiebaud, of the United States Army Engineer office at Frankfort, Ky.:

May 12, 1917: Gage height, 1.40 feet; discharge, 83.1 second-feet.

Daily discharge, in second-feet, of Eagle Creek at Glencoe, Ky., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept
1	9	26	51	146	260	380	273	193	5,540	30	58	48
2	9	26	51	122	193	870	12,600	115	4,390	30	45	32
3	9	22	45	9,570	138	722	3,830	85	1,350	465	45	26
4	9	22	40	3,500	138	1,500	488	122	345	146	30	22
5	9	22	225	6,380	138	870	2,880	96	810	90	22	18
6	9	22	183	2,580	138	488	6,510	90	442	62	22	14
7	9	22	193	810	138	810	810	75	273	45	18	14
8	9	22	115	286	138	3,400	510	75	248	40	18	345
9	9	22	96	193	138	3,190	930	75	3,400	32	14	193
10	9	26	85	173	138	1,500	695	75	2,780	30	14	85
11	9	22	66	155	138	930	442	96	488	28	14	66
12	9	22	51	108	138	4,740	286	578	260	26	11	58
13	9	22	45	164	138	7,280	260	260	173	22	11	58
14	9	22	40	122	138	5,900	214	115	930	22	11	45
15	9	22	40	85	138	1,660	193	130	330	26	11	40
16	9	22	40	85	138	510	193	75	183	40	11	30
17	9	22	40	85	138	330	146	66	155	138	11	26
18	9	22	40	85	85	314	122	58	122	70	11	24
19	9	22	40	85	108	260	115	51	96	183	11	18
20	35	22	40	85	300	214	108	45	80	80	11	18
21	35	22	40	3,830	248	5,080	108	40	70	70	11	18
22	35	22	40	13,500	173	2,010	96	40	66	85	11	45
23	58	28	115	1,200	1,420	532	85	35	58	108	11	28
24	85	122	214	300	2,780	4,960	85	35	51	40	11	22
25	75	193	193	214	236	810	85	35	45	138	11	22
26	58	138	362	164	183	362	80	32	45	173	9	18
27	48	90	14,700	155	314	2,380	75	13,200	40	130	9	14
28	42	90	5,420	465	420	810	75	22,300	35	80	9	14
29	38	75	1,060	895	....	362	75	2,380	35	58	9	11
30	35	75	345	1,060	....	260	314	465	32	58	9	11
31	26	....	273	380	....	225	....	622	....	58	54	....

Monthly discharge of Eagle Creek at Glencoe, Ky., for the year ending Sept. 30, 1917.

[Drainage area, 445 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	85	9	23.9	0.054	0.06
November	193	22	43.6	.098	.11
December	14,700	40	783	1.76	2.03
January	13,500	85	1,510	3.39	3.91
February	2,780	85	314	.706	.74
March	7,280	214	1,730	3.89	4.48
April	12,600	75	1,090	2.45	2.73
May	22,300	32	1,340	3.01	3.47
June	5,540	32	762	1.71	1.91
July	465	22	84	.189	.22
August	58	9	17.8	.040	.05
September	345	11	46.1	.104	.12
The year	22,300	9	650	1.46	19.83

GREEN RIVER BASIN.

GREEN RIVER AT MUNFORDVILLE, KY.

LOCATION.—At toll highway bridge at Munfordville, Hart County. Louisville & Nashville Railroad bridge is about a mile below highway bridge.

DRAINAGE AREA.—1,790 square miles (measure on map of Kentucky compiled by United States Geological Survey, scale 1: 500,000.)

RECORDS AVAILABLE.—February 27, 1915, to September 30, 1917.

GAGE.—Chain gage attached to upstream handrail of bridge; read by Chester Williams.

DISCHARGE MEASURMENTS.—Made from upstream side of bridge or by wading 100 feet below the bridge.

CHANNEL AND CONTROL.—The control for low stages is at a riffle used as a ford immediately below the bridge and is believed to be permanent; control at high stages is also believed to be permanent. Discharge relation may be affected to some extent at high stages by differences in the foliage on the brush and trees in the flood plain.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 35.5 feet at 5.30 a. m. January 7 (discharge, 31,400 second-feet); minimum stage, 2.85 feet at 5.30 a. m. July 7 (discharge, 128 seond-feet). Minimum discharge for 1916 was 118 second feet and not 144, as given in this paragraph in Water-Supply Paper 433.

Highest known stage, about 54 feet; date unknown.

ICE.—Ice seldom forms at this station.

ACCURACY.—Stage-discharge relation practically permanent; not affected by ice during the year. Rating curve well defined below and fairly well defined above 1,700 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Record good.

COOPERATION.—Station maintained in cooperation with the Kentucky Geological Survey, J. B. Hoeing, State geologist.

Discharge measurements of Green River at Munfordville, Ky., during the year ending Sept. 30, 1917.

[Made by B. E. Jones.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Jan. 24	34.65	29,500	Jan. 26	17.49	10,200	Jan. 27	8.82	4,5[illegible]
25	32.14	26,600	26	16.07	9,000	July 10	2.97	17[illegible]
25	29.51	21,800	26	12.77	7,050	11	2.99	17[illegible]

Daily discharge, in second-feet, of Green River at Munfordville, Ky., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	862	413	365	15,500	5,180	14,300	3,220	2,020	788	475	421	750
2	675	397	320	4,650	5,180	15,700	10,600	1,880	938	405	350	938
3	520	381	320	3,000	4,800	16,900	15,100	1,500	1,350	373	298	975
4	397	358	358	2,480	4,050	18,300	10,000	1,280	1,050	358	215	750
5	350	475	373	6,360	2,780	17,200	7,890	1,500	1,420	290	238	600
6	305	305	520	16,100	2,480	12,000	13,900	1,350	1,050	312	208	560
7	282	290	520	31,300	2,020	8,140	13,200	1,120	1,280	146	208	1,350
8	245	520	520	26,700	1,950	10,300	10,600	975	1,120	222	505	900
9	245	290	560	11,000	1,880	12,500	8,060	862	1,650	268	1,720	638
10	260	268	490	4,580	1,580	10,900	7,460	862	4,800	182	825	505
11	252	290	498	3,750	1,350	8,230	5,640	825	3.820	202	750	429
12	222	282	505	2,920	1,200	7,290	4,280	750	2,780	189	429	342
13	365	290	490	9,540	1,050	21,600	3,980	750	1,950	176	312	320
14	202	290	445	1,950	1,050	23,700	3,820	750	1,420	196	445	365
15	189	290	413	1,650	1,280	15,900	3,600	675	1,120	189	900	298
16	176	350	350	1,420	2,850	8,910	3,220	638	862	245	2,480	290
17	230	245	397	1,580	3,600	11,000	2,480	600	788	305	6,620	260
18	452	252	373	1,720	3,300	15,000	2,180	560	638	389	3,380	429
19	520	245	490	1,580	3,000	16,100	1,880	560	675	342	1,500	230
20	2,400	245	381	2,180	9,060	8,660	2,020	520	560	560	975	230
21	4.280	245	429	2,320	12,200	5,480	1,950	505	560	712	750	238
22	3.080	238	1,120	20.900	10,800	6,120	1.420	520	505	900	1,120	320
23	1 800	238	1,950	28,600	6,700	6,530	1,200	638	505	788	4,480	342
24	1,200	335	2,100	30,300	6,780	12,000	1.280	600	475	520	5,560	312
25	938	505	2,020	26.400	8,060	15,700	1,200	600	490	712	5,020	238
26	788	498	3.000	9,920	6,960	12,600	1,120	560	437	505	2,550	230
27	675	381	9,160	4,500	5,180	7,890	975	520	437	712	1,500	230
28	638	429	12,200	3,600	7,550	6,440	1,050	712	437	381	975	245
29	560	413	12,800	3,520	......	5,180	1,420	975	490	560	788	230
30	482	373	11,800	4,500	......	4,120	1,720	1,050	560	505	675	381
31	437	......	6,440	4,280	......	3,380	......	975	......	365	600	......

Monthly discharge of Green River at Munfordville, Ky., for the year ending Sept. 30, 1917.

[Drainage area, 1,790 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	4,280	176	775	0.433	0.50
November	520	238	338	.189	.21
December	12,800	320	2,310	1.29	1.49
January	31,300	1,420	9,320	5.21	6.01
February	12,200	1,050	4,420	2.47	2.57
March	23,700	3,380	11,600	6.49	7.48
April	15,100	975	4,880	2.73	3.05
May	2,020	505	891	.498	.57
June	4,800	437	1,160	.649	.72
July	900	146	403	.225	.26
August	6,620	208	1,510	.844	.97
September	1,350	230	464	.259	.29
The year	31,300	146	3,180	1.78	24.12

WABASH RIVER BASIN.

VERMILION RIVER NEAR DANVILLE, ILL.

Location.—In sec. 22, T. 19 N., R. 11 W., at Chicago & Eastern Illinois Railroad bridge, about 3 miles south of Danville, Vermilion County, 1¼ miles above Stony Creek, and 3 miles below mouth of North Fork.

Drainage area.—1,280 square miles.

Records available.—November 12, 1914, to September 30, 1917.

Gage.—Chain gage attached to downstream side of bridge; read by Ralph Bradbury till July 14 and by William Taylor afterward.

Discharge measurements.—Made from downstream side of bridge or by wading.

Channel and control.—Soft mud and sand; likely to shift.

Extremes of discharge.—Maximum stage recorded during year, 13.4 feet at 4.30 a. m. June 6 (discharge, 7,840 second-feet); minimum stage, 2.20 feet at 6.30 a. m. October 3 (discharge, 16 second-feet).

1915–1917: Maximum stage recorded, 18.9 feet January 31, 1916 (discharge, 12,800 second-feet); minimum stage, 2.00 feet November 20 and 23 to 25, 1915 (discharge, 15 second-feet).

Accuracy.—Stage-discharge relation not permanent; affected by ice and changed during high water in June. Rating curve used till June 5 fairly well defined between 35 and 10,000 second-feet; curve used after that date fairly well defined between 52 and 10,000 second-feet. Gage read to hundredths twice daily. Gage heights probably 1.0 foot in error for a period just before or after July 8. Daily discharge ascertained by applying mean daily gage height to rating tables. Records fair except for very low stages in October and November, for period affected by ice, and for period about July 8, for which they are poor.

Discharge measurements of Vermilion River near Danville, Ill., during the year ending Sept. 30, 1917.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1911.	*Feet.*	*Sec.-ft.*	1912.	*Feet.*	*Sec.-ft.*
Dec. 12	2.74	93	Aug. 13	2.74	113
June 22	4.00	621	13	2.74	118

Daily discharge, in second-feet, of Vermilion River near Danville, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	21	33	42			150	1,120	482	4,160	940	308	329
2	19	28	38			155	1,120	409	3,760	830	250	185
3	19	22	39			160	1,120	364	3,040	740	216	174
4	34	19	38			153	1,120	482	2,160	640	185	157
5	32	20	38	396	50	122	1,390	1,390	4,880	560	154	140
6	31	22	42			105	2,080	1,390	7,600	470	132	114
7	28	24	50			103	2,080	1,460	6,960	390	200	101
8	26	28	54			101	1,680	1,460	6,160	330	351	269
9	24	40	160			96	1,320	1,390	6,640	288	308	308
10	23	43	140			94	852	1,320	7,360	250	233	308
11	21	43				101	796	1,180	5,600	233	137	216
12	21	43				103	715	940	4,320	216	127	150
13	21	42				321	662	715	3,600	200	116	118
14	22	38				3,040	636	532	3,280	185	101	101
15	24	38	95	135	40	3,520	636	409	2,960	329	86	86
16	25	36				3,440	610	364	2,720	351	80	82
17	26	35				3,360	610	321	1,680	488	75	75
18	33	34				3,360	584	300	1,390	418	67	66
19	43	33				3,040	610	300	1,000	373	62	60
20	72	33				2,720	636	300	715	329	60	59
21	103	32				2,400	610	364	610	250	59	55
22	92	35				2,080	532	715	560	216	64	54
23	77	70				1,760	482	1,760	511	200	120	64
24	64	85				1,680	507	2,160	488	185	64	74
25	51	79	240	70	85	1,530	532	2,080	464	185	250	84
26	45	79				1,320	532	1,920	715	662	185	77
27	38	68				1,120	532	1,840	1,460	1,120	114	71
28	35	58				940	558	1,840	2,960	1,320	179	67
29	36	48			....	769	584	1,920	2,400	1,060	351	62
30	38	45			....	636	558	2,560	1,390	585	418	59
31	36	....			....	532	....	4,400	....	418	373	....

NOTE.—No gage height record for Mar. 2 and Sept. 23–24; discharge interpolated. Discharge estimated July 2–8 because of erroneous gage heights. Discharge Dec. 11 to Feb. 28 estimated because of ice, from gage heights, observer's notes, and weather records. Braced figures show mean discharge for periods included.

Monthly discharge of Vermilion River near Danville, Ill., for the year ending Sept. 30, 1917.

[Drainage area, 1,280 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	103	19	38.1	0.030	0.03
November	85	19	41.8	.033	.04
December	....	....	136	.106	.12
January	....	....	196	.153	.18
February	....	....	56.4	.044	.05
March	3,520	94	1,260	.984	1.13
April	2,080	482	860	.672	.75
May	4,400	300	1,200	.938	1.08
June	7,600	464	3,050	2.38	2.66
July	1,320	185	476	.372	.43
August	418	59	175	.137	.16
September	329	54	126	.098	.11
The year	7,600	....	635	.496	6.74

EMBARRASS RIVER AT STE. MARIE, ILL.

Location.—In sec. 30, T. 6 N., R. 14 W., at highway bridge at north end of Main Street, Ste. Marie, Jasper County, about 450 feet downstream from Cincinnati, Indianapolis & Western Railway bridge, and 2½ miles upstream from mouth of Hickory (or North Fork) Creek.

Drainage area.—1,540 square miles.

Records available.—October 20, 1909, to December 31, 1912; August 24, 1914, to September 30, 1917.

Gage.—Standard chain gage attached to bridge; read by V. C. Wuerth.

Discharge measurements.—Made from downstream side of highway bridge at ordinary stages; during high water made also from downstream side of five wooden trestles on Cincinnati, Indianapolis & Western Railway bridge, northwest of highway bridge.

Channel and control.—Measuring section is at a pool; control is about 1,800 feet below gage; may shift.

Extremes of discharge.—Maximum stage recorded during year, 21.2 feet at 8 a. m. June 6 (discharge, 14,000 second-feet); minimum stage recorded, 1.51 feet at 3 p. m. November 8 (discharge, 22 second-feet).

Flood of spring of 1908 reached a height of 22.5 feet on the present gage (discharge not determined). Minimum stage during periods of records, 1.1 feet September 5 to 9, 1914, and October 19, 1914 (discharge, 1.0 second-foot).

Accuracy.—Stage-discharge relation probably permanent throughout the year; seriously affected by ice during the winter. Rating curve fairly-well defined between 35 and 5,030 second-feet; above 5,030 second-feet it is based on an extension of curve for main river channel and estimated overflow. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage heights to rating table. Records fair, except for extremely low stages, for highest stages in June and for periods of ice effect.

Discharge measurements of Embarrass River at Ste. Marie, Ill., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Mar. 18	G. J. Trinkaus	12.97	3,090	May 25	H. C. Beckman	15.68	4,420
18	.....do	12.89	3,040	June 23	.....do	6.67	847
21	.....do	9.08	1,720	Aug. 14	.....do	3.97	344
21	.....do	8.85	1,630				

Daily discharge, in second-feet, of Embarrass River at Ste. Marie, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	41	27	34			272	1,030	4,210	4,850	855	1,560	212
2	40	27	30			257	3,160	3,390	5,230	731	1,140	335
3	38	26	30	650		184	2,100	2,340	5,860	639	780	257
4	36	25	34			170	2,180	1,560	4,970	596	731	212
5	34	25	28		115	143	1,380	1,980	5,690	514	684	184
6	34	25	30	3,570		130	1,170	1,590	13,600	422	1,060	170
7	34	23	30	3,080		130	830	1,260	8,240	386	1,060	170
8	33	22	34	2,380		130	980	1,260	7,190	369	1,030	156
9	32	31	42	1,940		124	1,080	1,140	6,650	352	905	335
10	30	30	79	1,260		124	1,230	1,030	6,220	335	639	1,080
11	27	34		639		124	830	955	5,690	303	514	1,450
12	26	30		534		227	661	855	5,230	272	554	1,520
13	26	30		476		980	596	780	4,670	257	386	980
14	28	32				3,910	534	684	3,660	257	335	554
15	34	35	45		80	5,160	476	514	3,340	257	272	458
16	33	34				4,370	458	514	2,980	272	242	369
17	31	33				3,340	422	514	2,620	287	227	319
18	30	30				3,160	404	495	1,940	476	227	257
19	34	28				2,220	404	458	1,590	404	212	242
20	33	27				1,900	386	386	1,350	335	198	212
21	31	27			476	1,520	369	386	1,140	272	184	198
22	35	27		270	707	1,060	335	1,350	980	242	177	184
23	37	35			980	1,200	335	4,370	890	227	335	170
24	34	35			880	1,260	335	5,230	830	212	198	156
25	34	34	235		596	1,800	335	4,160	707	198	184	143
26	39	33			422	1,620	335	3,440	639	198	163	130
27	34	32			335	1,590	404	2,020	617	3,210	156	124
28	33	34			272	1,450	3,810	4,260	1,030	4,260	156	117
29	33	43			....	980	3,860	5,160	955	2,340	156	117
30	30	38			....	856	3,080	4,730	880	2,140	272	104
31	29	....			....	731	....	3,960	....	1,620	272	....

NOTE.—Discharge interpolated for Oct. 3 and 4 and Mar. 30; estimated, because of ice, for Dec. 11 to Jan. 5 and Jan. 14 to Feb. 20, from gage heights, observer's notes and weather records. Braced figures show mean discharge for periods included.

Monthly discharge of Embarrass River at Ste. Marie, Ill., for the year ending Sept. 30, 1917.

[Drainage area, 1,540 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	41	26	33.0	0.021	0.02
November	43	22	30.4	.020	.02
December	....	....	102	.066	.08
January	3,570	....	709	.460	.53
February	980	....	236	.153	.16
March	5,160	124	1,330	.864	1.00
April	3,860	335	1,120	.727	.81
May	5,230	386	2,100	1.36	1.57
June	13,600	617	3,670	2.38	2.66
July	4,260	198	750	.487	.56
August	1,560	156	484	.314	.36
September	1,520	104	364	.236	.26
The year	13,600	....	912	.592	8.03

WEST BRANCH OF WHITE RIVER NEAR NOBLESVILLE, IND.

Location.—In sec. 16, T. 19 N., R. 5 E. At steel highway bridge known as Conners Bridge, about 4½ miles north of Noblesville, Hamilton County.

Drainage area.—900 square miles (measured on 1,500,000 scale map).

Records available.—May 13, 1915, to September 30, 1917.

Gage.—Chain gage attached to upstream side of bridge; read by Marvin Scearce.

Discharge measurements.—Made from downstream side of bridge or by wading.

Channel and control.—Coarse sand and gravel, strewn with boulders; probably permanent.

Extremes of stage.—Maximum stage recorded during year, 10.1 feet at 4.35 p. m. March 14; minimum stage, 1.26 feet 4.10 p. m. October 12.

Ice.—Stage-discharge relation affected by ice during severe winters.

Accuracy.—Stage-discharge relation probably permanent; probably affected by ice last part of December, middle of January and first half of February. Rating curve not determined. Gage read twice daily to hundredths. Station last visited on October 21, 1916.

Cooperation.—Gage-height record furnished by Noblesville Heat, Light & Power Co., Noblesville, Ind.

No measurements made at this station by engineers of Survey during the year.

Daily gage height, in feet, of West Branch of White River near Noblesville, Ind., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.46	1.36	1.47	2.69	3.35	2.73	4.79	4.46	5.39	3.33	....	1.55
2	1.45	1.36	1.48	2.51	3.56	2.55	5.47	5.38	4.36	3.70	....	1.55
3	1.44	1.36	1.48	2.38	4.45	2.49	4.42	5.42	3.71	3.22	....	1.57
4	1.42	1.36	1.47	2.35	....	2.56	5.01	5.56	3.46	2.60	....	1.55
5	1.39	1.36	1.50	2.75	4.17	2.57	5.22	5.78	4.11	2.22	1.63	1.54
6	1.35	1.36	1.51	7.12	....	2.44	6.52	6.41	5.01	2.26	1.64	1.49
7	1.34	1.35	1.52	6.87	....	2.28	7.17	4.71	5.61	2.30	1.63	1.50
8	1.34	1.30	1.51	5.27	....	2.20	6.22	4.31	4.36	2.31	1.60	1.97
9	1.29	1.38	1.43	3.97	3.27	2.66	4.67	4.11	4.06	2.34	1.59	1.55
10	1.28	1.33	1.44	3.65	....	3.25	3.62	3.72	5.58	2.46	1.49	1.57
11	1.28	1.29	1.48	3.35	....	3.27	3.52	3.62	5.48	2.44	1.59	1.56
12	1.27	1.40	2.04	3.17	2.83	5.22	3.32	3.49	4.48	2.34	1.56	1.55
13	1.31	1.44	3.43	2.84	....	6.77	3.07	3.31	3.74	2.41	1.56	1.57
14	1.35	1.42	2.63	2.56	....	9.71	2.87	3.16	3.56	2.56	1.57	1.54
15	1.36	1.38	2.38	4.01	....	8.87	2.79	2.80	3.24	4.61	1.59	1.54
16	1.34	1.38	2.39	6.03	2.81	6.22	2.74	2.72	3.01	4.36	1.58	1.54
17	1.34	1.35	2.52	....	....	4.47	2.61	2.65	2.90	4.01	1.54	1.43
18	1.36	1.38	2.39	....	....	4.37	2.76	2.58	2.70	3.96	1.51	1.37
19	1.41	2.70	2.34	5.19	2.83	4.07	3.37	2.50	2.60	3.16	1.49	1.37
20	1.50	2.70	2.10	....	4.92	3.27	4.16	2.44	2.52	2.76	1.47	1.37
21	1.50	2.68	....	5.99	5.47	3.72	3.92	2.48	2.54	2.62	1.47	1.36
22	1.52	3.06	2.98	5.48	5.17	3.72	3.72	2.76	2.45	2.33	1.50	1.39
23	1.44	5.56	3.33	5.97	3.31	3.77	3.42	3.51	2.42	2.20	1.47	1.41
24	1.45	4.43	....	5.39	2.82	4.97	3.86	3.26	2.42	2.11	1.49	1.44
25	1.44	3.58	....	4.83	2.71	5.22	4.46	3.01	2.36	2.07	1.47	1.39
26	1.40	1.37	2.92	4.29	2.61	4.52	5.06	2.84	2.37	2.71	1.47	1.38
27	1.36	1.38	....	4.17	3.05	4.77	5.46	4.06	3.17	2.51	1.44	1.38
28	1.38	1.38	....	3.55	2.98	4.87	4.76	4.56	4.61	2.34	1.41	1.38
29	1.36	1.37	2.76	3.47	....	3.52	4.36	5.24	3.96	....	1.44	1.37
30	1.36	1.48	....	3.27	....	3.57	3.86	5.65	3.60	....	1.49	1.33
31	1.36	....	2.92	3.29	....	3.28	....	5.84	....	....	1.53	....

LITTLE WABASH RIVER AT WILCOX, ILL.

Location.—In SW. ¼ sec. 3, T. 2 N., R. 8 E., at highway bridge at Wilcox, Clay County, about 6 miles southeast of Clay City and a quarter of a mile below mouth of Big Muddy Creek.

Drainage area.—1,130 square miles.

Records available.—August 22, 1914, to September 30, 1917.

Gage.—Standard chain gage attached to bridge; read by Hugh Holman.

Discharge measurements.—At ordinary stages made from downstream side of bridge, which is at a pool; during high water made also from bridge across drainage ditch and overflow section about half a mile east of the highway bridge.

Channel and control.—Heavy clay, probably permanent; control section is about 100 feet below the bridge. A determination by soundings August 22, 1914, indicates that there would be no flow past the gage if the stage were to fall to about 1.2 feet.

Extremes of discharge.—Maximum stage recorded during year 22.2 feet at 5 a. m. June 8 (discharge, 6,290 second-feet); minimum stage, 1.88 feet October 12 and 13 (discharge, 6.6 second-feet).

1914–1917: Maximum stage prevailed August 22, 1915 (gage inaccessible, discharge estimated as 10,000 second-feet); minimum stage recorded, 1.70 feet August 23, 1914 (discharge, 4 second-feet).

Accuracy.—Stage-discharge relation practically permanent; affected by ice during most of winter. Rating curve well defined between 63 and 420 second-feet, fairly well defined below 63 second-feet and between 420 and 3,360 second-feet, and poorly defined above 3,360 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good except for very high stages and for periods affected by ice, for which they are poor.

Discharge measurements of Little Wabash River at Wilcox, Ill., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 11[a]	H. C. Beckman	11.88	1,060	Sept. 13	H. C. Beckman	2.98	58.5
12[a]	.....do	7.01	476	13	.....do	2.97	57.6
Mar. 19[a]	G. J. Trinkaus	8.24	641				

[a] Measurement made during rapidly falling stage.

Daily discharge, in second-feet, of Little Wabash River at Wilcox, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	8.0	13	22	280		172	1,260	4,350	3,580	103	128	22
2	8.0	13	22	232		161	3,060	4,420	4,000	103	94	19
3	8.0	12	21	172		134	3,880	4,490	4,070	84	103	18
4	7.6	12	21	156		103	3,940	4,210	4,000	113	60	24
5	7.4	10	22	2,000	230	89	3,110	4,070	3,880	60	49	24
6	7.4	10	20	3,820		71	1,840	3,700	4,070	52	46	22
7	7.0	10	20	4,350		71	1,220	2,290	5,490	41	38	49
8	8.0	9	26	4,350		60	1,080	1,180	6,290	46	35	49
9	7.6	12	49	4,000		60	1,380	597	5,280	41	84	19
10	7.0	16	60	3,580		56	1,770	452	5,050	35	683	43
11	7.0	14				56	2,100	405	4,840	35	532	26
12	6.6	13				98	1,480	405	4,490	35	184	19
13	6.6	14				791	614	452	4,070	32	108	134
14	8.6	16				2,200	390	452	3,760	32	71	46
15	9.0	15	60	385	35	3,580	308	319	2,470	30	56	34
16	9.0	14				4,070	256	232	1,160	30	46	26
17	9.0	14				3,880	220	196	548	32	41	21
18	31	14				2,660	184	184	361	32	35	18
19	16	16				1,140	172	150	347	38	32	16
20	14	15				436	232	128	232	35	30	15
21	15	15			150	319	737	118	208	280	38	13
22	13	15			631	256	375	128	184	184	26	12
23	14	18			532	232	220	1,680	161	84	24	12
24	15	21			256	256	161	3,160	139	52	22	10
25	13	18	270	300	256	361	134	3,820	128	43	19	12
26	13	16			172	347	113	3,360	113	38	19	10
27	12	16			347	347	108	3,360	103	71	60	9.0
28	12	18			196	244	881	2,380	89	46	41	8.6
29	12	18			....	184	3,060	2,500	84	375	46	8.0
30	12	24			....	156	3,940	2,860	80	500	29	7.4
31	12	....			....	134	....	2,900	....	220	24	....

NOTE.—No gage height record for Nov. 13, 17, and 21, and Sept. 20 and 21; discharge interpolated. Discharge Dec. 11–31 and Jan. 11 to Feb. 20 estimated, because of ice, from gage heights, observer's notes, and weather records. Braced figures show mean discharge for periods included.

Monthly discharge of Little Wabash River at Wilcox, Ill., for the year ending Sept. 30, 1917.

[Drainage area, 1,130 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	31	6.6	10.8	0.0096	0.01
November	24	9.0	14.7	.013	.01
December	....	....	124	.110	.13
January	4,350	....	971	.859	.99
February	....	....	185	.164	.17
March	4,070	56	733	.649	.75
April	3,940	108	1,270	1.12	1.25
May	4,490	118	1,900	1.68	1.94
June	6,290	80	2,310	2.04	2.28
July	500	30	93.6	.083	.10
August	683	19	90.4	.080	.09
September	134	7.4	24.9	.022	.02
The year	6,290	6.6	645	.571	7.74

SKILLET FORK AT WAYNE CITY, ILL.

Location.—In sec. 18, T. 2 S., R. 6 E., at Southern Railway bridge 1 mile east of Wayne City, Wayne County, and about 4 miles below mouth of Horse Creek.

Drainage area.—481 square miles.

Records available.—August 16, 1908, to December 31, 1912; June 22, 1914, to September 30, 1917.

Gage.—Standard chain gage attached to bridge; read by J. C. Taylor.

Discharge measurements.—Made from downstream side of bridge; in high water also from downstream side of wooden trestle about 1 mile east of main channel. Low-water measurements made by wading below gage.

Channel and control.—Channel practically permanent; rough. Control is remains of rock dam at bridge section. A determination by leveling on August 20, 1914, indicated that there would be no flow past the gage if the stage fell to 1.6 feet.

Extremes of discharge.—Maximum stage recorded during year, 21.3 feet at 8 a. m. January 6 (discharge, 8,600 second-feet); minimum stage, 2.00 feet October 10 to 14 and September 25 to 30 (discharge, 0.8 second-foot).

Maximum stage recorded during periods of records, 23.1 feet August 22, 1915 (discharge, 15,800 second-feet); zero flow existed for 54 days in September to December, inclusive, of 1908.

Diversions.—About 30,000 gallons of water per day are pumped from river above gage into service tank of Southern Railway.

Accuracy.—Stage-discharge relation permanent; affected by ice during periods in winter. Rating curve fairly well defined between 15 and 5,000 second-feet, and poorly defined beyond these limits. Gage read to hundredths once daily. Daily discharge determined by applying daily gage height to rating table. Record good for medium stages; poor for very high stages and periods affected by ice. Determinations greater than 6,000 second-feet subject to considerable error because of poor definition and flatness of rating curve.

Discharge measurements of Skillet Fork at Wayne City, Ill., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	Sec.-ft.			Feet.	Sec.-ft.
Jan. 8	H. C. Beckman	20.20	4,180	Mar. 20	G. J. Trinkaus	3.99	123
13[a]	....do	3.72	87	June 25	H. C. Beckman	2.43	11.6
Mar. 20	G. J. Trinkaus	4.04	126	25	....do	2.43	12.4

[a] Ice along shores and some floating.

Discharge measurements of Cumberland River at Cumberland Falls, Ky., during the years ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec-ft.*			*Feet.*	*Sec.-ft.*
Jan. 7	B. E. Jones	8.85	34,100	Mar. 15	L. M. Sellier	4.82	10,700
8	.....do	8.25	29,700	July 13	B. E. Jones	1.23	80
Mar. 14	L. M. Sellier	5.82	14,200	14	.....do	1.22	78
15	.....do	5.03	10,700				

Daily discharge, in second-feet, of Cumberland River at Cumberland Falls, Ky., for the years ending Sept. 30, 1907–1912.

Day.	Aug.	Sept.	Day.	Aug.	Sept.	Day.	Aug.	Sept.
1907								
1		227	11		6,710	21	1,200	748
2		219	12		11,400	22	1,200	1,730
3		650	13		6,710	23	1,110	5,740
4		2,040	14		3,970	24	3,190	4,830
5		2,150	15	219	2,040	25	2,950	2,950
6		1,730	16	212	1,280	26	1,540	2,150
7		1,110	17	251	982	27	1,630	1,360
8		918	18	300	734	28	1,630	982
9		2,950	19	460	624	29	1,200	720
10		3,440	20	1,200	508	30	380	572
						31	300	....

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1907–8.												
1	472	186	1,830	11,800	5,740	7,400	12,300	3,700	982	219	320	166
2	412	284	1,540	6,380	9,700	19,200	18,100	3,440	870	243	320	148
3	360	380	1,360	4,250	8,510	18,600	19,200	3,440	950	235	277	132
4	350	2,830	1,280	4,250	5,430	17,500	17,500	3,700	1,280	219	268	111
5	350	2,480	1,110	9,300	4,830	8,130	12,800	3,970	1,200	219	260	142
6	496	1,630	1,010	12,300	6,710	6,710	6,710	6,710	982	235	251	1,280
7	870	1,280	886	9,300	12,800	8,510	5,430	7,760	902	822	243	3,190
8	1,280	1,010	762	6,710	10,500	7,400	4,540	8,130	822	1,830	235	2,480
9	2,040	1,450	637	4,540	7,760	6,380	3,700	8,130	790	3,190	219	1,450
10	2,600	5,430	650	3,440	6,060	5,130	3,190	6,380	678	2,150	206	1,030
11	2,040	12,300	650	2,830	22,100	5,430	3,190	4,830	520	1,450	776	720
12	1,360	12,300	762	4,540	19,200	7,050	3,190	3,700	380	1,110	624	496
13	1,030	5,430	854	6,710	10,500	6,060	3,190	3,190	310	822	496	320
14	762	3,190	886	7,760	7,400	9,700	3,190	2,600	277	650	380	206
15	598	2,830	998	6,060	25,000	7,760	3,190	3,970	243	624	340	166
16	496	2,260	1,280	4,830	22,100	5,430	5,130	3,700	212	870	300	137
17	412	1,630	1,450	6,060	17,500	5,430	5,430	3,190	193	2,370	268	121
18	360	1,730	1,730	7,050	7,400	9,700	4,540	2,480	166	2,040	251	111
19	310	2,260	1,830	5,430	5,130	19,200	3,700	1,730	153	982	219	100
20	268	3,190	1,630	3,970	4,250	17,500	3,440	1,940	142	4,830	179	92
21	251	3,440	1,540	3,440	3,700	11,400	3,190	1,830	132	2,950	193	92
22	219	3,440	1,630	2,710	3,190	8,130	2,710	1,630	121	1,540	227	84
23	212	4,830	1,730	2,480	2,710	6,710	2,260	1,450	111	1,280	235	84
24	212	11,800	1,630	2,260	2,600	5,740	2,040	1,280	100	1,050	219	76
25	186	16,400	3,700	2,040	2,480	5,430	5,740	1,110	121	734	206	68
26	179	10,500	3,700	1,830	2,260	4,830	19,200	982	520	533	193	60
27	160	5,130	3,190	2,040	2,710	4,250	17,000	950	678	380	251	60
28	153	3,700	2,710	2,260	4,540	3,700	11,400	950	546	310	251	60
29	153	2,950	2,480	2,150	4,540	3,700	6,710	950	400	277	219	64
30	153	2,150	7,760	2,040	....	4,250	4,540	1,080	235	251	206	58
31	179	....	16,400	2,480	....	6,060	....	1,110	....	268	173	....

Daily discharge, in second-feet, of Cumberland River at Cumberland Falls, Ky., for the years ending Sept. 30, 1907–1912—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1908–9.												
1	58	84	193	3,190	1,940	5,130	9,700	10,500	870	5,130	400	153
2	58	92	219	3,190	1,630	3,970	7,400	22,100	982	7,400	822	153
3	55	100	320	2,950	1,630	3,440	4,830	12,300	1,280	6,380	1,630	148
4	55	100	762	2,950	1,540	2,950	3,190	7,400	2,260	4,250	1,940	142
5	55	92	918	3,190	1,730	2,710	2,710	6,060	3,700	2,950	2,480	142
6	55	88	918	3,700	4,250	3,440	2,480	5,130	4,250	2,040	2,150	132
7	55	84	1,080	3,700	8,900	6,710	3,970	3,970	3,440	3,700	1,450	132
8	60	80	1,280	3,700	9,300	11,400	8,130	3,190	2,950	7,400	886	126
9	96	80	2,370	3,440	7,050	22,100	7,760	2,480	2,260	11,800	472	126
10	96	96	2,370	3,190	9,700	28,000	6,380	2,040	2,040	10,500	400	132
11	92	260	1,730	3,190	17,500	25,000	5,430	2,480	3,700	6,710	424	148
12	92	227	1,540	2,950	13,800	13,800	4,250	2,830	7,050	5,430	533	142
13	92	585	4,250	3,190	8,130	13,300	3,190	3,190	7,400	6,710	637	153
14	96	822	3,700	6,060	6,710	12,800	2,950	2,600	6,710	19,200	664	179
15	76	678	2,830	12,300	6,710	11,800	2,710	2,150	7,760	13,800	706	206
16	60	496	2,040	25,000	12,300	8,130	2,950	1,730	8,900	10,500	2,710	235
17	60	380	1,830	21,500	22,100	6,060	4,250	1,450	8,900	8,130	19,200	251
18	60	284	1,730	17,500	18,100	4,830	6,060	1,280	7,760	6,060	9,300	260
19	64	235	1,630	12,800	11,000	3,700	8.900	1,030	6,380	4,540	3,700	227
20	60	219	1,540	6,710	7,050	3,970	11,800	1,020	5,130	3,190	2,480	206
21	60	206	1,360	3,970	7,050	6,710	22,100	1,000	3,970	2,040	1,540	193
22	58	206	1,280	3,190	9,700	7,400	17,500	993	2,480	1,450	934	179
23	55	193	2,480	2,950	12,800	6,710	12,800	981	1,830	1,010	484	179
24	55	193	7,050	2,710	22,100	6,710	10,100	968	2,370	598	380	173
25	55	186	7,050	2,480	37,600	22,100	8,130	956	2,950	380	320	166
26	55	179	6,060	2,260	23,900	19,800	6,380	940	3,970	330	284	160
27	55	179	5,130	2,040	11,400	17,500	6,380	932	7,400	300	235	153
28	58	166	3,700	2,040	7,400	15,300	4,830	919	8,130	284	212	148
29	60	166	2,950	2,370	....	14,300	3,700	907	6,380	268	206	142
30	68	153	2,950	2,260	....	11,800	3,440	894	4,250	251	179	137
31	76	....	3,190	2,150	....	....	....	882	....	227	166	....
1909–10.												
1	137	166	268	520	2,710	4,250	734	6,710	4,250	902	3,440	193
2	132	153	320	508	2,600	8,510	692	4,250	3,970	918	2,830	300
3	126	148	460	496	2,370	7,760	734	3,700	2,700	1,080	2,040	496
4	121	142	637	496	2,150	6,060	870	3,440	3,440	1,110	2,710	918
5	121	142	902	692	2,040	5,430	1,010	3,190	3,190	1,280	3,700	3,190
6	111	132	1,080	2,480	1,830	4,540	998	3,700	2,950	1,730	4,250	2,950
7	111	132	1,280	8,900	1,630	3,700	918	4,250	2,950	2,260	4,830	2,950
8	100	132	1,280	31,200	1,450	2,950	822	4,540	2,710	2,260	6,060	3,440
9	100	142	1,360	10,500	1,280	2,480	748	5,740	2,710	7,400	5,740	3,970
10	105	153	1,450	7,760	1,280	2,150	706	8,900	2,600	6,710	4,540	6,710
11	111	153	1,450	6,060	1,280	1,940	678	11,800	5,430	6,060	3,700	6,060
12	121	148	1,360	5,130	1,540	1,830	762	13,800	8,130	5,430	3,440	5,430
13	132	142	1,280	4,250	1,830	1,730	950	13,300	6,710	5,130	2,830	5,130
14	148	142	1,110	3,190	2,040	1,730	1,280	10,500	6,380	4,830	2,370	4,830
15	166	132	1,080	2,710	2,260	1,630	1,450	8,130	5,740	4,540	1,830	3,970
16	179	132	1,010	2,600	2,600	1,630	1,630	6,380	5,430	4,540	1,360	6,060
17	206	142	950	3,190	3,440	1,540	3,190	4,830	4,540	6,380	1,080	2,600
18	227	166	886	4,250	22,100	1,450	7,050	3,700	3,970	8,130	886	2,260
19	251	251	854	6,710	16,400	1,450	8,130	3,190	2,950	7,760	678	1,830
20	251	484	790	11,000	13,300	1,360	7,760	2,830	2,260	6,380	572	1,540
21	243	572	734	12,800	11,400	1,280	7,050	2,830	1,730	5,430	546	1,440
22	235	533	706	10,500	9,300	1,280	6,710	3,190	1,540	4,830	496	1,340
23	227	496	692	7,760	7,400	1,110	7,400	3,440	1,280	3,970	472	1,240
24	219	533	678	6,380	6,710	1,090	8,510	4,250	1,540	3,440	436	1,140
25	219	572	650	6,060	5,740	1,030	9,700	10,100	1,200	2,710	390	1,040
26	206	472	624	5,430	4,830	966	10,500	13,300	1,200	1,830	360	940
27	199	360	598	5,130	4,250	918	11,400	11,800	1,450	2,040	320	840
28	193	424	598	4,250	3,700	854	11,800	10,500	1,280	1,940	284	740
29	186	340	572	3,700	....	822	11,400	8,130	1,080	2,040	251	640
30	179	268	546	3,190	....	776	9,700	6,380	982	6,710	212	540
31	166	....	533	2,950	....	748	....	4,540	....	4,830	193	....

Daily discharge, in second-feet, of Cumberland River at Cumberland Falls, Ky., for the years ending Sept. 30, 1907–1912—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1910–11.												
1	472	193	3,190	6,710	8,510	2,370	3,190	47,600	460	1,940	284	160
2	412	235	2,710	22,100	8,130	2,260	3,190	28,000	300	1,630	277	142
3	370	277	2,370	34,400	7,400	2,260	2,950	12,800	219	1,360	350	126
4	320	300	1,940	25,000	6,710	2,040	2,950	9,300	206	1,110	790	111
5	284	260	1,540	17,000	7,400	1,830	28,000	7,400	193	982	1,110	153
6	360	219	2,260	9,700	8,510	4,250	44,300	5,430	206	950	870	350
7	624	206	3,700	8,130	10,500	19,200	26,200	3,440	219	1,110	692	330
8	1,940	199	7,400	6,380	16,400	37,600	11,400	3,190	243	1,280	520	310
9	1,730	193	5,430	5,130	28,000	28,600	10,100	2,950	260	1,110	350	277
10	1,360	206	3,440	3,970	11,000	19,800	8,510	2,600	268	982	284	260
11	950	212	2,830	3,190	8,900	11,800	7,400	2,260	219	918	260	243
12	734	206	2,480	2,950	7,400	7,400	6,060	1,630	199	950	350	219
13	664	193	2,150	2,830	6,710	5,740	5,430	2,040	186	1,280	650	199
14	598	186	1,630	2,710	5,430	5,740	7,050	2,150	166	1,450	1,630	320
15	533	179	1,200	2,600	3,700	5,430	11,400	1,830	153	1,280	2,370	360
16	472	179	1,050	2,600	3,190	5,130	22,100	1,730	153	1,630	2,480	400
17	424	166	918	2,480	3,440	4,540	12,300	1,630	186	1,280	2,260	380
18	360	166	838	2,370	4,540	4,250	9,700	1,540	219	1,110	1,940	320
19	300	153	734	2,260	5,130	3,970	6,710	1,450	260	1,110	1,630	300
20	260	153	664	2,260	5,740	3,700	6,060	1,360	300	1,050	1,280	284
21	219	160	706	2,950	5,130	3,700	5,430	1,280	790	950	1,280	300
22	212	166	918	4,540	4,250	3,440	4,830	1,200	950	838	1,110	400
23	206	166	1,200	7,050	3,700	3,190	4,250	1,360	1,110	790	918	496
24	206	153	1,450	11,000	3,190	3,190	3,700	1,540	870	748	520	585
25	235	153	1,540	8,900	2,950	2,830	3,700	1,450	790	720	350	790
26	251	148	1,830	7,050	2,600	2,950	3,190	1,360	720	650	320	650
27	235	160	2,040	6,060	2,600	3,190	2,710	1,280	650	520	284	546
28	219	179	2,260	4,830	2,480	3,190	2,260	1,030	2,480	424	251	460
29	206	2,040	2,600	5,130	....	3,440	2,040	918	2,040	390	227	400
30	193	3,440	3,190	7,050	....	3,700	9,300	762	2,950	350	206	320
31	179	....	4,250	8,510	....	3,190	....	585	....	320	186	....

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1911.											
1	284	380	1,730	11	520	1,630	....	21	3,190	3,440	....
2	260	350	1,450	12	4,830	1,540	....	22	1,940	3,190	....
3	219	320	1,280	13	4,250	1,730	....	23	1,110	3,190	....
4	186	284	1,110	14	3,700	7,050	....	24	870	3,190	....
5	219	227	950	15	2,710	4,830	....	25	720	2,830	....
6	260	199	790	16	2,260	4,250	....	26	624	2,710	....
7	235	624	650	17	1,830	3,190	....	27	520	2,600	....
8	219	2,950	624	18	2,260	2,710	....	28	496	2,370	....
9	243	2,480	585	19	7,050	2,830	....	29	484	2,260	....
10	300	1,940	546	20	4,250	3,700	....	30	448	1,940	....
								31	412	....	....

Daily discharge, in second-feet, of Cumberland River at Cumberland Falls, Ky., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	153	275	578	4,760	7,260	9,930	3,850	2,440	770	428	954	1,460
2	513	259	604	2,920	7,260	24,900	4,450	2,110	1,090	630	714	1,890
3	338	259	476	4,760	7,260	40,700	5,410	1,780	1,200	428	890	1,560
4	243	243	440	24,200	4,760	45,600	5,080	1,360	1,020	338	1,000	1,180
5	195	227	452	37,200	3,570	44,200	4,760	1,360	890	306	830	954
6	167	211	464	37,200	2,800	37,900	7,680	1,200	800	275	700	770
7	153	203	464	34,400	2,330	28,800	11,400	1,090	714	243	500	604
8	139	195	452	29,500	2,440	14,000	9,930	1,060	742	227	404	488
9	125	188	452	15,600	2,560	6,100	6,860	1,020	860	211	380	404
10	115	181	428	4,760	2,110	5,750	5,080	1,000	1,000	195	686	338
11	105	174	416	3,180	2,000	4,760	3,850	988	920	181	920	296
12	100	167	552	2,560	1,780	10,900	3,300	954	905	167	1,070	259
13	211	167	552	2,110	1,670	24,200	3,050	1,090	830	153	845	235
14	211	195	552	3,300	1,360	15,600	2,800	1,130	800	139	604	211
15	174	211	513	7,260	1,890	10,400	2,560	988	728	160	552	195
16	153	211	452	8,550	3,180	7,680	2,440	830	630	1,780	2,800	167
17	167	211	380	5,750	3,850	29,500	2,220	658	500	4,450	3,850	153
18	714	195	348	4,450	3,570	32,300	2,110	578	440	5,750	2,440	139
19	1,780	188	380	4,760	3,850	26,200	1,780	452	714	4,450	1,460	125
20	1,890	181	404	5,080	15,600	15,600	1,670	686	742	3,850	1,020	115
21	3,570	174	464	4,760	23,000	6,860	1,460	578	686	2,560	770	105
22	2,680	181	1,090	14,000	21,000	6,860	1,360	658	742	2,680	604	95
23	1,780	203	3,850	19,800	11,900	6,100	1,180	617	428	3,180	1,000	90
24	1,200	219	5,080	15,600	16,200	21,000	1,070	890	728	3,180	1,090	85
25	860	211	3,300	7,680	18,000	24,200	971	988	672	3,300	2,560	85
26	644	526	2,330	4,450	14,000	22,300	860	890	630	4,150	1,460	115
27	513	714	1,780	3,300	7,680	15,600	770	604	604	3,300	954	380
28	428	714	9,930	2,800	5,410	12,400	714	500	591	3,850	672	488
29	370	644	24,200	2,800	....	10,900	1,140	604	714	2,920	526	770
30	338	552	22,300	7,680	....	7,680	1,890	1,130	476	2,000	428	770
31	296	....	15,000	7,680	....	4,760	....	1,020	....	1,360	526	....

NOTE.—On the following days the water was over the top of the gage and the gage height was estimated by comparison with the U. S. Weather Bureau readings at Burnside; determinations for single days are subject to considerable error, but the effect on the monthly mean would not be great: 1908, Feb. 11-12, 15-17, Mar. 2-4, 19-20, Apr. 2-4, 26-27; 1909, Jan. 16-18, Feb. 11, 17-18, 24-26, Mar. 9-11, 25-27, Apr. 21-22, May 2, July 14, Aug. 17; 1910, Jan. 8, Feb. 18-19; 1911, Jan. 2-5, Feb. 8-9, Mar. 7-10, Apr. 5-7, 16, May 1-2.

Monthly discharge of Cumberland River at Cumberland Falls, Ky., for years ending Sept. 30, 1907-1912, and 1917.

[Drainage area, 2,040 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1907.					
August 15-31	3,190	212	1,120	0.549	0.35
September	11,400	219	2,410	1.18	1.32
1907-1908.					
October	2,600	153	610	.299	.34
November	16,400	186	4,280	2.10	2.34
December	16,400	637	2,250	1.10	1.27
January	12,300	1,830	4,940	2.42	2.79
February	25,000	2,260	8,530	4.18	4.51
March	19,200	3,700	8,470	4.15	4.78
April	19,200	2,040	7,220	3.54	3.95
May	8,130	950	3,230	1.58	1.82
June	1,280	100	501	.246	.27
July	4,830	219	1,120	.549	.63
August	776	173	284	.139	.16
September	3,190	58	443	.217	.24
The year	25,000	58	3,470	1.70	23.10

Monthly discharge of Cumberland River at Cumberland Falls, Ky., for years ending Sept. 30, 1907–1912, and 1917—Continued.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1908–9.					
October	96	55	66.1	0.032	0.04
November	822	80	230	.113	.13
December	7,050	193	2,470	1.21	1.40
January	25,000	2,040	5,570	2.73	3.15
February	37,600	1,540	10,800	5.29	5.51
March	28,000	2,710	10,700	5.25	5.86
April	22,100	2,480	6,810	3.34	3.73
May	22,100	882	3,400	1.67	1.92
June	8,900	870	4,580	2.25	2.51
July	19,200	227	4,930	2.42	2.79
August	19,200	166	1,870	.917	1.06
September	260	126	167	.082	.09
The year	37,600	55	4,240	2.08	28.19
1909–10.					
October	251	100	169	.083	.10
November	572	132	263	.129	.14
December	1,450	268	863	.423	.49
January	31,200	496	5,830	2.86	3.30
February	22,100	1,280	4,980	2.44	2.54
March	8,510	748	2,420	1.19	1.37
April	11,800	678	4,510	2.21	2.47
May	13,800	2,830	6,620	3.25	3.75
June	8,130	982	3,240	1.59	1.77
July	8,130	902	4,020	1.97	2.27
August	6,060	193	2,030	.995	1.15
September	6,710	193	2,490	1.22	1.36
The year	31,200	100	3,110	1.52	20.71
1910–11.					
October	1,940	179	501	.246	.28
November	3,440	148	362	.177	.20
December	7,400	664	2,270	1.11	1.28
January	34,400	2,260	7,670	3.76	4.34
February	28,000	2,480	6,920	3.39	3.53
March	37,600	1,830	6,900	3.38	3.90
April	44,300	2,040	9,210	4.51	5.03
May	47,600	585	4,940	2.42	2.79
June	2,950	153	599	.294	.33
July	1,940	320	1,010	.495	.57
August	2,480	186	840	.412	.48
September	790	111	340	.167	.19
The year	47,600	111	3,440	.169	22.92
1911.					
October	7,050	186	1,510	.740	.85
November	7,050	199	2,360	1.16	1.29
December 1-10	1,730	546	972	.476	.18
1916–17.					
October	3,570	100	656	.322	.37
November	714	167	276	.135	.15
December	24,200	348	3,180	1.56	1.80
January	37,200	2,110	10,700	5.25	6.05
February	23,000	1,360	7,080	3.47	3.61
March	45,600	4,760	18,500	9.07	10.46
April	11,400	714	3,390	1.66	1.85
May	2,440	452	1,010	.495	.57
June	1,200	428	752	.369	.41
July	5,750	139	1,830	.897	1.03
August	3,850	380	1,070	.525	.61
September	1,890	85	484	.237	.26
The year	45,600	85	4,090	2.00	27.17

CUMBERLAND RIVER AT BURNSIDE, KY.

Location.—Below mouth of South Fork of Cumberland River, at Burnside, Pulaski County.

Drainage area.—4,890 square miles (measured on maps of Kentucky and Tennessee. prepared by United States Geological Survey on scale 1 : 500,000).

Records available.—October 1, 1914, to September 30, 1917.

Gage.—Vertical staff in two sections on piers of toll bridge across South Fork of Cumberland River about 700 feet above mouth; installed in July, 1914, by United States Weather Bureau. Readings on this gage by the Weather Bureau began January 1, 1915. Sea-level elevation of zero, 589.53 feet (Smith Shoals Survey datum, United States Engineer Corps), this datum being same as that of gage which was marked on the rails of inclines 1 and 2 leading from the South Fork to the warehouse, about 500 feet below the present gage, and which was established in 1884 and read daily until January 1, 1915. Upper part of old gage, reading from 54 to 71 feet, was spiked to office of Col. Cole. The United States Weather Bureau[1] reports that "the old river gage was changed on several unknown dates and by amounts that are uncertain, so that readings prior to January 1, 1915, are not comparable by from 0.1 to 0.7 foot." New gage is read for the United States Geological Survey by L. M. Cheeley.

Discharge measurements.—Flow of South Fork is measured from the highway bridge; the Cumberland above the South Fork is measured from a boat from the Queen & Crescent Railroad bridge, or by means of floats, the method used depending on the stage: flow below the South Fork is the combined flow of both streams.

Channel and control.—Channel considered permanent except for deposits of mud, which are washed away at high stages. Low-water control is crest of dam No. 21, 28 miles below Burnside; gage height of crest of dam, 1.47 feet. The dam is a recently built concrete structure, and probably little or no water leaks through dam or lock.

Extremes of discharge.—Maximum stage recorded during year, 51.4 feet at 4 p. m. January 5 (discharge, roughly, 115,000 second-feet); minimum, 1.97 feet, July 13 and 14, due to lowering of pool to flood steamer off bar below lock.

Maximum stage recorded, 62 feet March 31, 1886; minimum, —1.6 feet November 8 and 9, 1895; at present lowest stage possible is 1.47 feet, unless pool No. 21 is lowered.

Ice.—Stage-discharge relation seldom affected by ice.

Regulation.—Stage at low water will be affected by any manipulation of the level of pool No. 21 at the lock.

Accuracy.—Stage-discharge relation practically permanent; not materially affected by ice during 1915, 1916, and 1917. Rating curve fairly well defined to 30,000 second-feet (gage height approximately, 20 feet); curves extend above 30,000 second-feet and may be considerably in error. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height or daily gage height to rating table. Gage readings October 1, 1914, to February 18, 1915, obtained from gage readings at Lock No. 21, and the Weather Bureau's old and new gages. At low-water stage discharge relation may be affected by water entering between the gage and the dam due to heavy local showers in the basins of the small intervening tributaries. Results are good for discharge less than 30,000 second-feet.

Cooperation.—Station maintained in cooperation with the Kentucky Geological Survey, J. B. Hoeing, State geologist.

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[1] Daily river stages, pt. 12, p. 29.

Discharge measurements of Cumberland River at Burnside, Ky., during the year ending Sept. 30, 1917.

[Made by B. F. Jones.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Jan. 10	11.94	12,400
11	8.63	8,390
July 13	1.95	270

Daily discharge in second-feet, of Cumberland River at Burnside, Ky., for the years ending Sept. 30, 1915-1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1914-15.												
1	510	1,230	1,230	28,500	23,000	2,580	5,570	1,890	7,820	6,500	900	5,920
2	350	1,230	1,450	17,900	74,000	2,350	5,000	1,670	6,620	7,260	955	4,420
3	350	1,010	1,450	10,900	50,700	2,240	4,420	1,890	7,260	5,460	1,230	3,380
4	350	800	2,580	7,960	29,400	2,120	4,080	4,300	10,100	5,000	2,350	2,700
5	280	700	7,540	6,380	19,700	2,460	3,730	6,260	6,870	11,800	2,580	3,040
6	280	700	24,800	5,340	19,900	5,460	3,380	5,220	5,110	13,900	2,000	5,460
7	150	700	19,700	9,300	17,600	7,820	3,160	4,190	5,000	10,400	1,450	6,870
8	150	700	11,300	18,500	13,200	7,000	2,920	3,620	10,400	7,680	1,120	5,110
9	150	700	6,030	17,800	10,400	5,920	2,810	3,270	10,500	5,920	1,010	4,080
10	280	700	5,680	12,700	8,400	5,220	2,580	2,920	7,960	4,880	1,120	3,160
11	510	700	4,540	9,300	7,000	4,650	2,920	2,460	5,570	4,880	1,560	2,580
12	1,010	700	3,730	22,200	5,800	4,190	3,500	2,120	4,190	7,820	6,030	2,120
13	1,450	700	3,500	48,600	5,340	3,730	4,420	1,890	3,500	14,100	5,680	1,780
14	3,960	700	3,380	32,400	4,650	3,380	4,300	1,670	3,160	31,000	5,220	1,450
15	6,260	700	3,160	21,100	4,650	3,160	3,960	1,560	4,300	23,000	4,650	1,230
16	47,300	700	2,920	14,600	4,650	3,380	3,500	2,450	11,300	13,000	4,880	1,120
17	29,600	700	2,580	11,800	5,110	4,650	3,160	1,230	15,000	7,960	3,730	955
18	15,900	700	2,350	14,500	4,650	6,380	2,920	1,060	9,600	6,030	5,220	900
19	15,500	700	2,700	55,600	4,650	9,450	2,700	955	6,740	4,650	9,900	850
20	10,200	700	4,760	46,000	4,300	17,600	2,460	850	5,680	4,080	7,960	700
21	6,030	510	29,400	28,100	3,960	19,500	2,350	900	7,540	10,200	7,820	1,010
22	4,880	510	34,100	17,000	3,730	15,900	2,120	900	11,500	9,000	8,550	1,340
23	3,380	510	22,400	11,800	3,500	12,900	2,120	2,120	9,300	6,030	6,380	2,000
24	3,160	510	15,400	14,300	3,270	11,700	1,890	10,200	6,500	4,190	4,420	1,780
25	2,700	510	11,000	16,300	3,160	11,500	1,780	7,400	4,650	3,040	3,270	1,400
26	2,580	510	38,200	17,800	3,040	11,500	1,670	5,570	3,380	2,240	2,460	1,180
27	2,350	510	28,100	18,700	2,920	10,200	1,670	13,900	2,700	1,780	2,120	1,010
28	2,120	510	16,600	15,700	2,700	9,750	1,670	22,000	2,000	1,450	11,300	850
29	1,780	510	12,700	13,600	......	8,850	1,670	19,300	2,240	1,180	16,300	800
30	1,450	1,010	48,600	9,600	......	7,260	1,890	16,100	3,160	1,060	11,500	3,160
31	1,230	......	46,500	9,000	......	6,140	......	9,300	......	955	8,250	......

Daily discharge in second-feet, of Cumberland River at Burnside, Ky., for the years ending Sept. 30, 1915–1917—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915–16.												
1	22,800	1,560	6,380	35,300	11,000	6,030	9,900	3,960	11,000	1,060	1,890	750
2	34,800	1,450	5,570	36,500	18,300	7,820	8,250	3,620	6,740	900	1,340	900
3	22,600	1,400	5,110	37,200	18,900	14,300	7,000	3,380	4,650	750	2,460	850
4	14,500	1,280	4,650	25,900	15,000	15,700	6,260	4,540	3,620	660	2,920	800
5	12,400	1,280	4,420	17,800	12,000	13,600	5,680	6,620	2,810	650	4,650	955
6	17,400	1,120	3,840	14,300	10,900	11,200	5,000	5,460	2,460	573	3,620	955
7	12,000	1,060	3,500	25,700	10,900	11,500	4,420	4,540	3,270	555	3,730	850
8	8,100	1,060	3,160	68,900	10,400	17,900	7,260	3,730	5,460	537	7,260	750
9	5,920	1,060	2,920	47,000	10,400	18,400	15,500	3,270	5,460	600	9,150	650
10	4,650	1,890	2,810	29,000	15,700	15,000	16,100	2,810	4,420	1,400	7,680	630
11	3,500	2,120	2,700	20,300	18,100	11,200	13,600	2,460	3,620	4,190	4,650	650
12	3,040	2,000	3,730	32,700	16,100	9,000	10,700	2,120	3,620	3,620	3,960	564
13	2,580	3,500	5,460	44,200	13,000	7,000	9,000	1,890	7,540	3,960	7,540	650
14	2,240	8,700	6,260	56,000	10,500	6,260	7,680	1,670	7,260	3,270	6,030	800
15	2,000	82,800	6,260	32,400	8,100	5,680	6,620	1,560	5,680	2,460	5,800	800
16	1,890	86,700	18,300	19,900	6,870	5,680	5,920	1,670	4,880	2,120	10,500	670
17	1,780	46,000	61,900	14,600	6,260	5,460	5,920	1,670	4,760	2,000	13,000	630
18	1,780	22,200	105,000	11,200	5,800	5,000	4,760	1,450	5,220	2,580	9,300	1,400
19	3,040	26,500	99,500	8,550	5,460	4,760	4,300	1,280	4,760	3,270	6,870	1,120
20	22,200	35,300	71,500	7,400	4,890	4,420	3,840	1,120	3,960	5,570	5,220	850
21	13,600	23,500	46,000	7,260	4,420	4,300	3,500	1,060	3,380	8,250	3,730	630
22	7,540	16,100	27,400	10,900	3,960	4,420	3,500	1,060	2,810	11,200	2,810	454
23	5,340	11,000	13,200	31,700	3,840	4,190	3,620	1,120	2,460	11,200	2,350	630
24	4,300	8,250	8,400	30,800	4,190	3,960	3,620	1,280	2,000	6,870	2,000	528
25	3,380	6,620	7,960	20,700	5,800	3,730	3,730	1,780	1,670	4,510	1,670	502
26	2,920	5,570	11,500	14,300	6,870	3,730	3,620	1,780	1,560	3,500	1,670	470
27	2,460	5,110	17,900	10,900	7,260	5,800	3,620	1,780	1,450	3,040	1,400	406
28	2,240	5,920	19,500	8,550	7,260	14,300	3,840	1,670	1,340	2,810	1,230	398
29	2,000	8,700	48,600	7,820	6,500	20,300	3,960	1,280	1,280	1,890	1,060	1,010
30	1,890	7,540	77,700	8,250	....	16,300	3,960	4,300	1,230	1,560	1,010	750
31	1,780	....	50,700	7,820	....	12,400	....	20,900	....	2,350	750	....
1916–17.												
1	600	850	1,340	14,500	21,100	21,500	9,300	4,650	2,700	750	3,160	1,120
2	555	800	1,230	7,960	22,400	51,200	13,000	4,420	2,810	630	2,460	2,240
3	620	750	1,180	9,000	16,100	89,500	41,500	3,620	5,340	591	2,240	2,810
4	630	700	1,120	43,500	12,500	94,000	16,300	3,380	4,420	650	2,240	2,810
5	582	670	1,180	112,000	9,150	87,900	15,700	3,500	3,380	573	1,900	2,460
6	510	610	1,280	103,000	6,740	63,200	29,000	3,380	2,580	519	1,500	1,890
7	486	591	1,400	71,000	5,920	48,100	28,300	3,160	2,240	486	1,400	1,450
8	486	582	1,670	50,100	5,340	39,800	22,600	2,920	2,000	470	1,180	1,120
9	454	555	1,560	29,000	5,570	27,600	17,600	2,810	2,120	454	1,010	1,010
10	454	546	1,670	13,900	5,110	17,000	13,700	2,700	2,810	446	1,180	900
11	406	510	1,670	8,250	4,420	13,200	10,200	2,580	3,730	446	1,780	750
12	398	537	1,670	6,260	3,840	21,500	8,250	2,460	3,500	422	1,890	670
13	343	573	1,670	5,220	3,500	47,500	8,400	2,460	2,810	420	1,890	630
14	383	630	1,560	6,030	3,380	35,300	7,960	2,350	2,460	420	1,560	573
15	438	610	1,560	13,900	4,420	27,600	7,400	2,350	2,120	573	1,340	486
16	610	600	1,450	16,400	9,300	20,100	6,140	2,240	1,670	7,000	3,270	486
17	1,670	591	1,280	13,200	11,000	53,800	5,460	2,000	1,560	7,820	6,870	446
18	1,670	600	1,230	10,100	10,100	82,800	5,000	1,890	1,280	15,000	6,140	438
19	4,540	600	1,180	10,400	9,750	50,900	4,420	1,780	1,120	10,200	4,190	406
20	7,400	591	1,180	11,200	45,200	30,600	3,960	1,670	1,010	8,550	2,920	390
21	7,960	582	1,670	11,000	60,500	18,900	3,620	1,450	1,120	6,260	2,120	366
22	7,000	573	4,300	45,800	39,000	20,700	3,160	1,280	1,120	9,750	2,350	358
23	4,760	591	9,450	61,800	25,700	18,700	3,040	1,340	1,120	10,100	4,760	329
24	3,160	1,010	10,100	32,400	34,800	13,000	2,810	2,000	1,060	11,200	3,960	329
25	2,350	1,180	7,820	19,300	41,200	58,700	2,700	2,120	955	11,000	3,380	329
26	1,890	1,400	5,680	12,200	26,500	37,200	2,460	2,000	850	8,550	3,270	329
27	1,560	1,450	4,760	8,700	17,800	31,700	2,350	1,780	750	7,540	2,350	1,120
28	1,280	1,560	25,000	7,260	13,200	33,900	2,120	2,460	700	8,100	1,780	2,580
29	1,060	1,450	71,500	7,680	....	24,800	2,120	3,840	519	8,400	1,400	2,920
30	1,010	1,400	42,500	20,700	....	17,000	3,380	3,960	690	5,680	1,120	2,580
31	955	....	25,900	18,700	....	11,700	....	3,160	....	4,190	1,010	....

Monthly discharge of Cumberland River at Burnside, Ky., for the years ending Sept. 30, 1915–1917.

[Drainage area, 4,890 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1914–15.					
October	47,300	150	5,360	1.10	1.27
November	1,230	510	702	.144	.16
December	48,600	1,230	13,500	2.76	3.18
January	55,600	5,340	18,800	3.84	4.43
February	74,000	2,700	12,300	2.52	2.62
March	19,500	2,120	7,390	1.51	1.74
April	5,570	1,670	3,010	.616	.69
May	22,000	850	5,100	1.04	1.20
June	15,000	2,000	6,660	1.36	1.52
July	31,000	955	7,630	1.56	1.80
August	16,300	900	4,900	1.00	1.15
September	6,870	700	2,410	.493	.55
The year	74,000	150	7,320	1.50	20.31
1915–16.					
October	34,800	1,780	7,960	1.63	1.88
November	86,700	1,060	14,200	2.90	3.24
December	105,000	2,700	24,300	4.97	5.73
January	68,900	7,260	24,000	4.91	5.66
February	18,900	3,840	9,610	1.97	2.12
March	20,300	3,730	9,340	1.91	2.20
April	16,100	3,500	6,490	1.33	1.48
May	20,900	1,060	3,120	.638	.74
June	11,000	1,230	4,010	.820	.91
July	11,200	537	3,160	.646	.74
August	13,000	750	4,430	.906	1.04
September	1,400	398	733	.150	.17
The year	105,000	398	9,310	1.90	25.91
1916–17.					
October	7,960	343	1,810	.370	.43
November	1,560	510	790	.162	.18
December	71,500	1,120	7,640	1.56	1.80
January	112,000	5,220	25,800	5.28	6.09
February	60,500	3,380	16,900	3.46	3.60
March	94,000	11,700	40,000	8.18	9.43
April	29,000	2,120	9,400	1.92	2.14
May	4,650	1,280	2,640	.540	.62
June	5,340	519	2,020	.413	.46
July	15,000	420	4,750	.971	1.12
August	6,870	1,010	2,510	.513	.59
September	2,920	329	1,140	.233	.26
The year	112,000	329	9,630	1.97	26.72

SOUTH FORK OF CUMBERLAND RIVER AT NEVELSVILLE, KY.

Location.—One-fourth mile below Turkey Creek ferry, on Greenwood-Monticello pike about a mile from Nevelsville, McCreary County. Little South Fork enters on left about 1¾ miles above station.

Drainage area.—1,260 square miles (measured on maps of Kentucky and Tennessee, compiled by United States Geological Survey, on scale 1:500,000).

Records available.—March 10, 1915, to September 30, 1917.

Gage.—Vertical staff gage in 5 sections bolted to rock ledges on left bank; read by Mart Keith and Ben Whitehead. A reference gage for use in referencing soundings at the measuring section, is attached to a tree on the left bank 110 feet below cable.

Discharge measurements.—Made from cable about 2,000 feet below gage, or by wading.

CHANNEL AND CONTROL.—Channel straight above and below; bed, compact gravel. Low-water control is partly the bed of the river below gage and partly a gravel bar about 2 miles below gage. Both are probably permanent. High-water control is bed of stream for several miles below gage, and may be slightly affected by foliage along the banks.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 35.1 feet, at 5.30 p. m., March 3 (discharge, roughly, 55,000 second-feet; minimum stage, 1.82 feet, at 5.30 a. m., July 13 (discharge, 64 second-feet).

ICE.—Stage-discharge relation seldom if ever affected by ice.

REGULATION.—Operation of a small power plant short distance above gage may affect flow at extreme low water.

ACCURACY.—Stage-discharge relation probably permanent; not affected by ice during period of record. Rating curve well defined to 23,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent.

COOPERATION.—Station maintained in cooperation with State Geological Survey of Kentucky, J. B. Hoeing, State geologist.

Discharge measurements of South Fork of Cumberland River at Nevelsville, Ky., during the year ending Sept. 30, 1917.

[Made by B. E. Jones.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Jan. 9	7.35	3,250	July 17	17.92	17,800
July 17	12.13	9,900	18	13.27	10,200
17	16.51	15,500			

Daily discharge, in second-feet, of South Fork of Cumberland River at Nevelsville, Ky., for the years ending Sept. 30, 1915–1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915.												
1							1,410	630	1,160	3,150	430	1,740
2							1,290	523	1,410	1,950	452	1,480
3							1,220	658	1,740	1,290	800	1,100
4							1,160	4,000	1,350	4,180	860	920
5							1,040	3,000	1,040	5,850	602	1,740
6							980	1,950	1,540	6,070	430	4,880
7							920	1,410	2,860	3,230	310	4,000
8							860	1,290	4,980	2,080	256	2,570
9							800	1,160	4,470	1,480	292	1,740
10						1,480	770	980	2,710	1,220	256	1,350
11						1,350	800	800	1,680	1,040	1,350	1,100
12						1,220	1,040	685	1,350	2,080	2,430	920
13						1,100	1,680	630	1,290	2,500	1,880	712
14						980	1,540	575	1,290	6,070	1,160	602
15						920	1,290	523	3,480	3,560	2,150	499
16						1,220	1,160	430	8,860	2,360	2,010	430
17						1,880	1,040	388	4,670	2,430	1,350	388
18						2,290	920	329	2,710	1,540	3,560	348
19						3,000	860	292	1,950	1,480	4,000	310
20						5,410	740	274	1,540	1,610	3,000	292
21						4,880	712	256	1,740	17,200	4,280	388
22						3,560	658	256	2,860	5,080	3,650	920
23						3,000	630	348	2,080	2,640	1,880	860
24						2,570	575	3,000	1,350	1,680	1,480	575
25						2,290	523	1,410	980	1,220	1,100	430
26						2,150	523	1,610	770	920	800	348
27						2,010	475	5,080	630	685	1,610	292
28						2,010	452	3,480	549	602	11,800	256
29						1,810	452	2,710	499	452	5,960	1,540
30						1,610	1,040	1,740	1,220	388	4,000	1,540
31						1,480		1,220		329	2,710	

Daily discharge, in second-feet, of South Fork of Cumberland River at Nevelsville, Ky., for the years ending Sept. 30, 1915–1917—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915–16.												
1	15,600	658	1,810	6,530	3,000	1,680	2,570	800	4,090	224	348	274
2	13,100	602	1,610	15,200	5,960	2,860	2,150	740	2,220	194	1,160	274
3	4,180	549	1,480	13,400	4,570	4,670	1,950	712	1,480	228	1,680	310
4	2,500	499	1,350	6,880	3,390	4,000	1,810	1,160	1,160	188	1,100	409
5	3,560	452	1,220	4,670	2,930	3,150	1,610	1,160	1,040	161	1,040	409
6	6,300	430	1,100	4,280	2,780	2,710	1,410	1,040	860	175	1,350	169
7	3,560	409	980	19,400	2,710	3,390	1,350	920	1,480	137	1,160	274
8	2,430	409	920	27,500	2,360	5,300	2,780	800	3,150	127	920	256
9	1,740	740	860	9,140	2,360	4,280	5,190	712	1,810	348	1,680	224
10	1,350	1,740	800	5,630	3,650	3,310	4,180	630	1,220	1,950	1,410	188
11	1,100	1,160	800	4,570	3,820	2,780	3,310	549	920	2,570	980	172
12	920	1,160	1,220	4,000	3,320	2,290	2,860	499	2,080	1,810	3,000	168
13	800	3,390	1,350	16,100	2,780	1,950	2,360	452	5,960	1,950	4,880	175
14	712	7,000	1,350	14,700	2,430	1,810	2,080	430	3,310	1,220	2,710	158
15	630	57,000	1,290	5,850	1,950	1,680	1,810	452	2,150	980	2,430	155
16	602	22,700	4,380	4,570	1,740	1,610	1,610	630	1,610	800	3,230	182
17	575	7,630	10,600	3,910	1,610	1,410	1,410	475	1,350	770	4,570	452
18	549	4,280	43,000	3,000	1,540	1,350	1,350	409	1,220	1,350	3,230	329
19	5,080	15,600	22,700	2,430	1,410	1,290	1,220	368	920	1,610	2,500	256
20	17,900	13,700	7,500	2,360	1,220	1,220	1,100	348	770	2,780	1,610	188
21	5,960	6,880	4,570	2,360	1,160	1,160	1,100	329	685	5,520	1,160	158
22	3,310	4,380	3,310	3,910	1,040	1,220	1,350	310	630	6,640	920	139
23	2,290	3,150	2,710	14,400	1,040	1,160	1,410	368	575	3,390	712	152
24	1,740	2,570	2,290	7,500	1,290	1,040	1,350	475	475	2,010	602	155
25	1,410	2,150	2,500	4,670	2,360	890	1,160	1,160	452	1,290	475	132
26	1,220	1,740	6,760	3,480	2,360	1,410	1,100	740	549	1,290	452	118
27	1,040	1,740	5,850	2,860	2,150	2,640	1,100	523	409	1,040	388	107
28	920	3,150	5,190	2,430	1,880	7,500	1,100	409	348	860	329	107
29	920	2,500	25,100	2,290	1,740	6,880	980	368	310	630	368	107
30	860	2,150	25,100	2,150	....	4,470	860	3,560	256	475	368	147
31	740	....	8,030	1,950	....	3,230	....	13,100	....	388	329	....
1916–17.												
1	169	142	238	2,500	6,530	6,880	2,640	1,160	292	137	1,040	658
2	142	137	218	2,010	4,770	13,400	4,280	860	575	118	800	1,160
3	132	132	214	3,910	3,150	41,700	6,180	740	712	109	770	1,040
4	116	122	221	23,500	2,570	33,200	4,090	770	712	107	1,040	1,480
5	109	118	238	36,100	2,290	24,300	5,850	920	549	102	712	920
6	98	118	310	26,700	1,740	9,000	12,800	920	452	98	575	602
7	92	113	329	9,000	1,680	6,420	8,030	800	388	90	388	499
8	86	107	310	4,880	1,610	5,410	5,190	800	348	107	329	388
9	80	107	329	3,390	1,680	4,090	4,470	800	475	102	329	329
10	86	107	368	2,640	1,480	3,310	3,820	800	1,160	98	1,160	310
11	94	109	409	2,080	1,290	2,710	3,150	712	1,160	90	1,290	256
12	127	107	409	1,680	1,160	9,700	2,640	685	980	71	740	231
13	147	107	388	1,350	1,040	11,300	2,360	630	740	65	523	207
14	132	109	348	2,430	1,040	7,000	2,360	575	575	73	409	185
15	113	113	310	6,530	1,740	6,880	2,080	523	452	920	575	169
16	116	113	292	4,280	2,860	5,850	1,740	475	368	5,960	3,910	158
17	113	109	256	3,310	3,150	33,300	1,540	430	310	9,000	3,650	152
18	118	107	256	2,930	2,860	25,300	1,350	388	274	10,100	2,500	144
19	169	105	256	3,820	4,980	8,030	1,220	348	238	4,380	1,540	348
20	292	102	221	3,650	13,400	4,880	1,100	329	256	2,640	1,040	172
21	430	105	329	3,390	22,000	4,570	1,040	310	214	3,080	800	120
22	409	102	2,220	20,100	7,240	8,300	980	310	207	7,000	1,220	107
23	368	113	3,000	15,800	4,470	6,420	860	452	228	6,880	1,350	221
24	310	164	2,080	6,300	12,100	22,200	800	549	238	7,120	1,220	188
25	256	204	1,480	4,090	7,500	18,600	740	499	235	5,410	740	109
26	214	329	1,160	3,000	4,380	7,000	712	388	207	3,820	549	98
27	178	348	980	2,360	3,310	10,300	658	368	164	2,930	409	185
28	164	274	11,800	2,150	2,860	13,400	602	348	137	3,000	348	1,100
29	142	256	30,600	3,150	....	6,880	1,040	329	164	2,640	310	1,740
30	142	238	6,420	14,700	....	4,570	1,040	292	137	2,010	292	860
31	147	....	3,560	6,530	....	3,310	....	256	....	1,410	274	....

Monthly discharge of South Fork of Cumberland River at Nevelsville, Ky., for years ending Sept. 30, 1915-1917.

[Drainage area, 1,260 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1915.					
March 10-31	5,410	920	2,190	1.74	1.42
April	1,680	452	919	.729	.81
May	5,080	256	1,340	1.06	1.22
June	8,860	499	2,160	1.71	1.91
July	17,200	329	2,790	2.21	2.55
August	11,800	256	2,160	1.71	1.97
September	4,880	256	1,140	.905	1.01
1915-16.					
October	17,900	549	3,340	2.65	3.06
November	57,000	409	5,680	4.51	5.03
December	43,000	800	6,380	5.06	5.83
January	27,500	1,950	7,170	5.69	6.56
February	5,960	1,040	2,430	1.93	2.08
March	7,500	980	2,720	2.16	2.49
April	5,190	860	1,850	1.47	1.64
May	13,100	310	1,120	.889	1.02
June	5,960	256	1,450	1.15	1.28
July	6,640	127	1,390	1.10	1.27
August	4,880	329	1,520	1.21	1.40
September	452	107	212	.168	.19
The year	57,000	107	2,950	2.34	31.85
1916-17.					
October	430	80	171	0.136	0.16
November	348	102	147	.117	.13
December	30,600	214	2,240	1.78	2.05
January	36,100	1,350	7,360	5.84	6.73
February	22,000	1,040	4,460	3.54	3.69
March	41,700	2,710	11,900	9.44	10.88
April	12,800	602	2,850	2.26	2.52
May	1,160	256	573	.455	.52
June	1,160	137	432	.343	.38
July	10,100	65	2,570	2.04	2.35
August	3,910	274	995	.790	.91
September	1,740	98	471	.374	.42
The year	41,700	65	2,850	2.26	30.74

CANEY FORK NEAR ROCK ISLAND, TENN.

Location.—About 100 feet downstream from power house of Tennessee Power Co., half a mile downstream from mouth of Collins River, and 1 mile northwest of Rock Island, Warren County.

Drainage area.—1,640 square miles (measured on Post Route Map).

Records available.—November 14, 1911, to September 30, 1917.

Gage.—Bristol water-stage recorder, known as gage No. 3, 100 feet downstream from power house and about half a mile downstream from Rock Island dam; this gage has been used to determine the mean daily stage since January 1, 1917. From March 26 to December 31, 1916, a Bristol water-stage recorder installed March 26, 1916, at site of staff gage known as gage B (No. 2), half a mile upstream from gage No. 3 and 300 feet downstream from Rock Island dam, was used for determining mean daily stages. The closing of sluice gates in dam on December 8, 1916, and diversion of flow through tunnel on December 12 made gage B useless after December 7, 1916. Prior to March 26, 1916, daily mean stage was determined from a water-stage recorder known by the Billesby Co., as gage A, 400 feet upstream from gage B, just above point at which dam is now built; date of installation of recorder not known. Backwater from dam began to affect stage-discharge relation at gage A March 26, 1916.

Discharge measurements.—Formerly made from cable at gage B or from sluiceways in dam. No discharge measurements have been made since closing of the sluiceways December 8, 1916.

Channel and control.—Bed of stream above and below gage consists chiefly of solid rock; probably permanent.

Extremes of discharge.—Maximum discharge during year, about 55,000 second-feet (estimated by comparison with flow of Collins River); March 4, stage unknown; minimum stage, 0.35 foot November 20 (discharge, 330 second-feet).

1911–1917: Maximum stage recorded, 13.2 feet April 2, 1912 (discharge, 107,000 second-feet); minimum stage 0.20 foot September 17, 20, 21, and October 4, 5, 10, 1914 (discharge, 220 second-feet).

Regulation.—Prior to December 8 only slight diurnal fluctuation caused by operation of small mills upstream. After that date considerable regulation resulted from storage in reservoir above.

Accuracy.—Stage-discharge relation practically permanent. Rating curve used prior to December 8 well defined between 300 and 25,000 second-feet, and extended above. Above 4,700 second-feet and below 430 second-feet curve is based on rating curve constructed by the H. M. Billesby Engineering Co., Chicago, Ill. Rating curve used subsequent to January 1 developed by means of simultaneous gage readings at gage B (No. 2) and gage No. 3, and based upon the above curve, is fairly well defined between 300 and 9,000 second-feet and extended above. Mean daily gage heights computed by Tennessee Power Co. Daily discharge ascertained by applying mean daily gage height to rating table. Records good except for extreme high stages.

Cooperation.—Gage-height record furnished by Tennessee Power Co.

The following discharge measurement was made by L. J. Hall:

November 10, 1916: Gage height (gage No. 2 B), 0.41 foot; discharge, 367 second-feet.

Daily discharge, in second-feet, of Caney Fork near Rock Island, Tenn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	510	510	510	5,260	9,090	7,220	4,870	1,490	1,260	1,490	1,490	1,090
2	430	510	600	4,350	9,770	36,100	5,260	1,450	1,570	1,300	2,040	1,060
3	470	430	690	4,520	6,670	50,900	4,080	1,370	1,950	1,160	1,490	2,220
4	510	430	690	13,800	5,470	55,000	4,190	1,410	1,950	1,090	1,490	2,040
5	470	395	690	14,200	4,690	39,700	17,300	1,450	2,040	985	1,490	1,490
6	430	360	740	21,700	3,730	20,900	23,700	1,370	1,530	820	1,410	1,410
7	430	360	790	12,600	3,320	10,100	14,500	1,370	1,530	760	1,370	1,410
8	430	395	....	8,440	3,190	6,160	12,600	1,120	1,200	730	1,410	1,410
9	690	395	....	5,690	3,320	3,190	12,600	1,450	5,260	700	1,410	1,410
10	690	430	....	4,350	2,950	4,190	8,760	1,370	4,520	450	1,410	1,340
11	555	395	....	3,320	2,620	4,350	4,870	1,300	5,470	450	1,410	1,300
12	555	395	....	2,840	2,520	5,690	5,470	1,340	4,030	591	1,300	1,260
13	470	360	....	2,420	2,220	13,000	4,030	1,160	1,530	510	1,200	1,120
14	430	430	....	3,190	2,180	16,100	4,190	1,200	1,450	332	985	1,020
15	430	395	....	4,870	2,420	16,900	3,590	1,120	1,450	450	880	1,020
16	360	395	....	4,870	3,450	12,600	3,730	1,120	1,370	1,300	1,160	675
17	430	360	....	4,350	4,870	30,500	2,620	1,120	1,370	29,300	1,300	730
18	510	430	....	4,690	5,470	25,300	2,620	1,020	1,410	18,500	1,340	625
19	510	395	....	5,690	10,400	15,300	1,770	985	1,090	10,100	1,300	600
20	690	330	....	5,260	18,100	9,770	1,730	950	1,060	6,410	1,260	600
21	890	360	....	4,690	18,900	9,430	2,570	1,020	5,060	4,350	1,300	470
22	1,070	395	....	23,700	11,900	12,600	2,080	985	1,900	3,190	1,340	470
23	890	430	....	19,700	8,440	12,200	1,900	1,060	1,650	4,350	1,300	470
24	790	360	....	10,800	6,160	22,500	1,690	1,090	2,320	4,350	1,340	470
25	740	555	....	7,810	6,670	23,300	1,650	985	1,370	3,320	1,340	470
26	645	600	....	5,470	4,870	16,500	1,530	985	1,300	2,000	1,340	470
27	555	555	....	4,030	3,320	22,100	1,450	915	1,200	3,730	1,300	490
28	430	555	....	3,880	2,370	17,300	1,450	2,180	1,300	6,940	1,300	2,220
29	430	510	....	23,700	....	9,770	1,530	3,730	1,200	4,690	1,300	3,320
30	430	555	....	19,700	....	8,120	1,530	3,190	1,340	3,070	880	2,840
31	470	....	....	12,600	....	6,940	....	1,490	....	1,490	700	....

NOTE.—Records Oct. 1 to Dec. 7 obtained from gage B (No. 2) at site immediately below dam, which represents normal flow. Dec. 8 to 31 the flow past gage B was regulated by closing of sluice gates in dam. Diversion of water through tunnel at power house, about half a mile below gage B, was begun Dec. 12. Records for this period omitted. Discharge Mar. 3 and 4 estimated by comparison with records of flow of Collins River.

Records Jan. 1 to Sept. 30, obtained from gage No. 3 at site 100 feet below power house and about half a mile below gage B, represent total flow, which is however, subject to considerable regulation from dam above.

Monthly discharge of Caney Fork near Rock Island, Tenn., for the year ending Sept. 30, 1917.

[Drainage area, 1,640 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,070	360	559	0.341	0.39
November	600	330	432	.263	.29
December 1-7	790	510	673	.410	.11
January	23,700	2,420	8,790	5.36	6.18
February	18,900	2,180	6,040	3.68	3.83
March	55,000	3,190	17,500	10.7	12.34
April	23,700	1,450	5,330	3.25	3.63
May	3,730	915	1,380	.842	.97
June	5,470	1,060	2,060	1.26	1.41
July	29,300	332	3,840	2.34	2.70
August	2,040	700	1,310	.799	.92
September	3,320	470	1,180	.720	.80

COLLINS RIVER NEAR ROWLAND, TENN.

LOCATION.—At Hennessee's iron highway bridge, 1 mile below Mountain Creek, 2½ miles northeast of Rowland, Warren County, 5 miles southwest of Rock Island, and about 8 miles upstream, by river, from junction of Collins River with Caney Fork, a tributary of Cumberland River.

DRAINAGE AREA.—800 square miles (measured by Tennessee Power Co.).

RECORDS AVAILABLE.—April 1, 1916, to September 30, 1917.

GAGE.—Standard chain gage on downstream side of bridge at middle of second span from right bank; read by Joe Keathley. Zero of gage, 795.86 feet, above sea level.

DISCHARGE MEASUREMENTS.—Made from upstream handrail of bridge, or at extremely low stages, by wading. A stay wire about 100 feet upstream is used to make high-water measurements.

CHANNEL AND CONTROL.—Bed composed of rock, boulders and sand. Channel fairly straight for a considerable distance above and below gage; right bank is a steep rock bluff; left bank is low and subject to overflow above a stage of 8 feet. A series of rock and boulder riffles beginning just below bridge forms the control; probably permanent.

EXTREMES OF DISCHARGE.—1916–17: Maximum stage recorded, 14.1 feet at 12 m. March 4, 1917 (discharge, 28,900 second-feet); minimum stage, 1.10 feet several days in November, 1916 (discharge, 120 second-feet).

By means of levels the elevation of marks of the flood of 1854 (exact date unknown), reported by old residents nearby, indicates that the river rose to stage 32.6 feet (discharge estimated at 82,200 second-feet). Elevation of marks of the flood of 1902 (exact date unknown), obtained in the same manner, indicates a stage of 27.2 feet (estimated discharge, 66,600 second-feet).

ICE.—Stage-discharge relation not affected by ice.

REGULATION.—Small mills upstream probably cause some diurnal fluctuation.

ACCURACY.—Stage-discharge relation practically permanent; not affected by ice. Rating curve well defined below 8,000 second-feet and extended above that point. Gage read to hundredths twice daily; oftener during high water. Daily discharge ascertained by applying mean daily gage height to rating table. Records good. Determination of discharge above stage of overflow (about 8 feet, discharge, 11,300 second-feet) subject to error.

COOPERATION.—Gage-height record furnished by Tennessee Power Co.

Discharge measurements of Collins River near Rowland, Tenn., during the years ending Sept. 30, 1916 and 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1916.		*Feet.*	*Sec.-ft.*	1916.		*Feet.*	*Sec.-ft.*
Mar. 24	L. J. Hall	1.98	782	Aug. 19	L. J. Hall	1.61	491
30	do	3.18	2,150	22	do	1.55	409
Apr. 19	Warren E. Hall and L. J. Hall	1.98	801	Sept. 14	Warren E. Hall and L. J. Hall	1.32	241
26	L. J. Hall	2.25	1,080	20	L. J. Hall	1.35	263
May 18	do	1.55	408	26	do	1.28	222
24	do	2.37	1,220				
June 16	do	2.54	1,420	1916–17.			
19	do	2.05	867	Oct. 25	do	1.30	221
23	do	1.95	768	Nov. 11	do	1.18	143
July 19	do	3.54	2,600	15	do	1.20	158
21	do	3.85	2,930	Jan. 10	do	2.94	1,910
22	do	4.32	3,590	31	do	4.56	3,930
24	do	2.96	1,890	Feb. 24	do	3.70	2,720
Aug. 12	do	1.86	727	Mar. 28	do	5.99	6,510
14	do	2.28	1,110	Apr. 11	do	3.73	2,930
17	do	1.82	658	May 18	do	1.62	460

Daily discharge, in second-feet, of Collins River near Rowland, Tenn., for the years ending Sept. 30, 1916 and 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1916.							1916.						
1....	1,450	744	726	494	708	334	16....	964	462	1,520	2,610	744	438
2....	1,270	636	494	478	735	717	17....	900	414	1,250	2,070	636	334
3....	1,180	672	771	398	800	494	18....	860	406	1,050	3,100	528	286
4....	1,270	860	1,200	422	840	478	19....	810	390	860	2,480	462	270
5....	1,150	997	920	422	800	382	20....	762	390	931	2,940	462	256
6....	1,040	820	1,030	478	564	374	21....	1,470	390	1,160	3,100	462	242
7....	997	699	2,090	438	840	318	22....	1,930	494	880	3,300	430	228
8....	1,520	636	1,430	1,160	780	446	23....	1,650	840	771	2,670	486	214
9....	1,780	582	880	10,900	840	374	24....	1,400	1,210	780	1,880	478	214
10....	1,630	494	681	11,600	830	358	25....	1,210	942	636	1,510	462	200
11....	1,510	510	744	9,320	708	334	26....	1,100	690	582	1,250	446	214
12....	1,370	478	3,300	7,430	681	294	27....	986	510	502	1,180	390	193
13....	1,210	470	4,300	6,330	900	294	28....	900	430	462	1,460	366	200
14....	1,120	470	2,550	7,320	1,050	334	29....	850	382	422	1,030	398	186
15....	1,050	438	1,650	3,790	910	681	30....	771	1,490	462	1,120	350	193
							31....	......	975	......	870	342	......

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1916-17.												
1	186	214	173	2,450	4,150	6,540	2,130	681	920	398	1,030	1,790
2	160	214	207	1,730	4,000	16,200	2,550	753	690	406	820	1,600
3	186	180	214	1,970	2,850	28,000	2,310	762	636	366	762	1,480
4	180	180	214	5,920	2,310	27,700	2,530	1,160	920	334	654	975
5	180	167	256	4,800	2,050	18,500	9,080	800	1,120	326	582	762
6	173	152	214	9,080	1,710	4,890	11,200	726	820	294	546	609
7	167	173	214	4,890	1,490	4,800	6,020	762	690	286	510	494
8	173	173	221	3,010	1,470	3,790	4,460	744	1,030	270	510	454
9	310	173	235	2,330	1,450	2,920	4,630	672	3,860	256	406	953
10	228	180	228	1,850	1,290	2,550	3,440	681	3,440	256	462	699
11	214	160	302	1,610	1,150	2,940	2,790	645	2,620	242	430	502
12	186	173	302	1,300	1,140	3,440	2,330	600	1,780	249	414	438
13	173	152	302	1,080	964	5,720	2,090	546	1,240	242	366	406
14	173	160	270	1,930	953	6,220	1,890	555	964	256	390	342
15	180	140	263	2,330	1,120	5,820	1,770	528	780	302	690	366
16	152	120	242	2,130	1,530	4,150	1,480	510	672	2,350	2,120	334
17	173	144	228	1,930	1,420	18,500	1,370	446	582	11,100	1,180	358
18	214	136	214	2,010	1,530	9,080	1,270	430	537	4,890	870	302
19	228	180	228	2,410	2,770	4,630	1,220	462	478	3,720	654	294
20	358	144	214	2,300	6,120	3,510	1,070	446	528	2,270	564	278
21	302	173	342	2,050	6,980	3,580	1,020	422	1,010	2,050	470	286
22	242	152	502	7,200	4,150	4,720	931	519	942	2,000	502	717
23	249	160	771	6,540	3,100	4,630	830	591	681	2,310	681	470
24	242	160	850	3,930	2,770	8,840	870	528	582	1,930	564	374
25	214	160	681	2,850	2,290	8,360	771	510	462	1,510	478	326
26	200	160	690	2,290	1,930	5,160	790	478	398	1,470	430	286
27	207	167	1,210	1,830	1,710	9,320	627	414	430	2,500	390	1,490
28	193	160	10,200	2,360	1,610	6,120	663	414	382	3,170	350	5,530
29	200	193	11,600	6,980	......	4,150	762	430	502	1,900	350	2,060
30	152	186	4,300	7,200	......	3,170	699	446	528	1,450	390	1,260
31	200	......	2,670	4,000	......	2,560	......	672	......	1,210	1,050	......

Monthly discharge of Collins River near Rowland, Tenn., for the years ending Sept. 30, 1916 and 1917.

[Drainage area, 800 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1916.					
April	1,930	762	1,200	1.50	1.67
May	1,490	382	643	.804	.93
June	4,300	422	1,170	1.46	1.63
July	11,600	398	3,020	3.78	4.36
August	1,050	342	627	.784	.90
September	717	186	329	.411	.46
1916–17.					
October	358	152	206	.258	.30
November	214	120	166	.208	.23
December	11,600	173	1,240	1.55	1.79
January	9,080	1,080	3,360	4.20	4.84
February	6,980	953	2,360	2.95	3.07
March	28,000	2,550	7,760	9.70	11.18
April	11,200	627	2,450	3.06	3.41
May	1,160	414	591	.739	.85
June	3,860	382	1,010	1.26	1.41
July	11,100	242	1,620	2.02	2.33
August	2,120	350	633	.791	.91
September	5,530	278	874	1.09	1.22
The year	28,000	120	1,860	2.32	31.54

TENNESSEE RIVER BASIN.

FRENCH BROAD RIVER AT ASHEVILLE, N. C.

Location.—At new concrete highway bridge which replaced old Smith's bridge; washed out July 16, 1916, about a mile below Southern Railway station at Ashe, ville, N. C., and 2 miles below mouth of Swannanoa River.

Drainage area.—987 square miles.

Records available.—March 19, 1903 (determinations of daily discharge from Jan. 1, 1905) to July 16, 1916; January 1 to September 30, 1917. A record was obtained at Bingham School bridge about three miles west of Ashville from 1895 to 1905.

Gages.—A temporary vertical staff a short distance above the old Smith's bridge was used January 1 to September 30, 1917. Original gages, a vertical staff attached to one of the piers of the old Smith's bridge, and an auxiliary chain gage (for obtaining readings below zero) attached to that bridge, were used until the flood in July, 1916. Readings from the temporary gage have been reduced to the datum of the original gage.

Discharge measurements.—Formerly made from downstream side of highway bridge.

Channel and control.—Bed composed chiefly of rock; practically permanent. Control formed by rock shoal and concrete piers of Southern Railway bridge; permanent, though piers of bridge may become choked with débris during extreme floods, so that stage-discharge relation at gage may be affected by backwater for short periods.

Extremes of discharge.—Maximum stage recorded during year, 4.2 feet March 5 and 25 (discharge, 9,770 second-feet); minimum stage recorded during year, −0.7 foot August 30 (discharge, 680 second-feet).

1905–1917: Maximum stage recorded, 24.13 feet July 16, 1916, determined from flood marks by levels November 21, 1917 (discharge not determined); stage-discharge relation probably affected by backwater from drift lodged against the Southern Railway bridge. Maximum stage recorded before or after the flood in July, 1916, 7.8 feet January 23, 1906 (discharge, 25,800 second-feet). Minimum recorded, −0.7 foot September 16 and 20, 1907 (discharge, 380 second feet.)

ICE.—Stage-discharge relation not affected by ice.

REGULATION.—Slight diurnal fluctuations may be caused by the operation of small mills upstream.

ACCURACY.—Stage-discharge relation changed slightly by the flood in July, 1916. Rating curve based on four discharge measurements made in 1918; well defined below 10,800 second-feet. Gage read to tenths once daily. Daily discharge determined by applying daily gage height to rating table. Records fair.

COOPERATION.—Gage-height record furnished by United States Weather Bureau.

No discharge measurements were made at this station during the year.

Daily discharge, in second-feet, of French Broad River at Asheville, N. C., for the year ending Sept. 30, 1917.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,640	2,100	2,360	1,860	1,860	1,210	930	1,210	7,020
2	1,530	2,810	3,300	1,640	1,860	1,420	930	1,110	5,750
3	1,640	1,980	4,430	1,750	1,750	1,530	1,050	1,750	5,750
4	1,640	1,640	6,760	1,420	1,640	1,420	1,420	1,210	2,650
5	1,640	1,860	9,770	4,050	2,100	1,210	1,310	1,110	1,980
6	2,810	1,640	8,620	7,020	1,860	1,310	1,210	1,110	1,750
7	2,360	1,530	4,630	4,840	1,640	1,110	1,020	1,020	1,420
8	1,980	1,530	3,860	3,860	1,980	1,210	1,210	1,420	1,310
9	1,860	1,640	3,480	4,240	1,860	1,530	1,110	1,640	1,530
10	1,640	1,420	2,810	3,300	1,640	2,500	930	1,980	2,100
11	1,530	1,310	2,650	2,970	1,530	1,640	930	1,420	1,640
12	1,310	1,310	2,500	2,810	1,530	1,310	930	1,110	1,310
13	1,310	1,310	2,970	2,810	1,640	1,310	1,020	1,110	1,310
14	1,310	1,210	2,500	2,650	1,420	1,210	840	930	1,210
15	2,500	1,310	2,360	2,500	1,420	1,310	840	1,980	1,110
16	3,480	1,640	2,360	2,650	1,530	1,310	930	1,420	1,210
17	3,300	1,310	2,500	2,360	1,420	1,110	840	1,110	1,110
18	2,650	1,310	3,480	2,360	1,420	1,110	1,210	1,020	1,020
19	2,500	2,100	2,650	2,360	1,530	1,110	1,860	1,020	1,110
20	2,230	3,480	2,360	2,230	1,310	1,310	2,100	840	1,020
21	1,980	4,840	2,360	2,100	1,310	1,210	2,100	840	1,020
22	1,980	3,130	2,650	2,100	1,310	1,640	2,230	1,020	1,210
23	2,360	2,650	2,500	2,230	2,230	1,420	2,100	930	1,420
24	1,980	2,970	7,800	1,980	1,640	1,110	2,500	930	1,310
25	1,750	3,130	9,770	1,980	1,420	1,020	2,230	840	1,110
26	1,750	2,650	9,190	2,230	1,980	1,110	1,750	840	1,110
27	1,640	2,360	7,020	2,100	1,420	1,020	1,530	760	1,020
28	1,530	2,360	6,760	1,860	1,420	1,110	1,750	760	3,130
29	1,640	....	5,060	1,980	1,530	1,210	1,310	760	3,480
30	1,980	....	4,050	1,860	1,310	1,110	1,110	680	2,100
31	1,640	....	2,100	....	1,210	....	1,020	760	....

Monthly discharge of French Broad River at Asheville, N. C., for the year ending Sept. 30, 1917.

[Drainage area, 987 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
January	3,480	1,310	1,970	2.00	2.31
February	4,840	1,210	2,090	2.12	2.21
March	9,770	2,100	4,370	4.43	5.11
April	7,020	1,420	2,670	2.71	3.02
May	2,230	1,210	1,600	1.62	1.87
June	2,500	1,020	1,300	1.32	1.47
July	2,500	840	1,360	1.38	1.59
August	1,980	680	1,120	1.13	1.30
September	7,020	1,020	2,010	2.04	2.28

TENNESSEE RIVER AT CHATTANOOGA, TENN.

LOCATION.—At Walnut Street Bridge in Chattanooga, Hamilton County, 3 miles above mouth of Chattanooga Creek, 4 miles below mouth of Chickamauga Creek, and 33 miles upstream from Hales Bar dam.

DRAINAGE AREA.—21,400 square miles (measured on topographic maps).

RECORDS AVAILABLE.—April 1, 1873, to October 21, 1913; March 1, 1915, to September 30, 1917.

GAGES.—Two gages, 7 miles apart and set to the same datum, are used at this station to determine variation in slope of water surface caused by operation of power plant and locks at Hales Bar dam, as the station is within influence of backwater from the dam. Gage No. 1 consists of a sloping section of a railroad T rail, bolted to rock, and a vertical section of timber attached to the rock cliff on the left bank about 200 feet upstream from the Walnut Street Bridge; read by O. B. Gladish and L. M. Andress. Gage No. 2 is a vertical staff in three sections, fastened to trees on left bank about 100 feet above the Cincinnati Southern Railroad bridge 7 miles upstream from Chattanooga; gage is read by C. A. Brown.

Prior to October 21, 1913, gage No. 1 was used alone, but on that date backwater from Hales Bar dam began to affect the stage-discharge relation, and the station was abandoned until March 1, 1915, when gage No. 2 was installed.

DISCHARGE MEASUREMENTS.—Made from downstream footway of Walnut Street Bridge.

CHANNEL AND CONTROL.—Channel practically permanent. Control now formed by Hales Bar lock and dam and power plant.

EXTREMES OF DISCHARGE.—Maximum stage during year, from records of United States Weather Bureau, 47.7 feet at 8.40 a. m. March 7, (discharge, 313,000 second-feet); minimum mean daily discharge, 11,000 second-feet, October 8.

1874–1917: Maximum stage recorded, 64.0 feet at 7 a. m. March 1, 1875 (discharge 361,000 second-feet); minimum stage recorded, zero on gage September 11–14, 1881, and September 19, 1883 (discharge, 4,800 second-feet).

ICE.—Stage-discharge relation not affected by ice.

REGULATIONS.—See "Accuracy."

ACCURACY.—Stage-discharge relation affected by changes in slope of water surface caused by operation of power plant at Hales Bar dam and by rising and falling stages. Discharge determined by slope method (see Water-Supply Paper 345). Rating curve well defined between 11,500 and 363,000 second-feet. Gages read to hundredths twice daily. Records fair.

Discharge measurements of Tennessee River at Chattanooga, Tenn., during the year ending Sept. 30, 1917.

[Made by L. J. Hall.]

Date.	Gage height in feet.		Discharge.	Date.	Gage height in feet.		Discharge.
	Gage No. 1.	Gage No. 2.			Gage No. 1.	Gage No. 2.	
Oct. 14[a]	7.42	9.57	11,200	Mar. 10	35.93	38.60	195,000
Mar. 9	44.20	46.50	276,000	31	23.38	26.49	113,000
9	42.80	45.20	262,000				

[a] Three-foot flash boards on Hales Bar dam.

Daily discharge, in second-feet, of Tennessee River at Chattanooga, Tenn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	13,500	13,300	15,200	90,300	96,100	78,300	90,700	28,300	20,200	18,300	26,700	18,200
2	13,100	13,500	16,800	68,500	98,100	117,000	79,900	31,700	21,200	17,400	23,900	29,600
3	13,100	13,700	17,600	51,600	92,000	224,000	72,800	33,000	22,100	16,200	22,900	34,000
4	13,100	13,300	15,800	54,500	76,200	223,000	63,200	33,000	21,800	16,200	24,100	32,900
5	12,800	12,300	15,200	73,800	65,800	237,000	72,000	33,000	21,000	14,500	23,900	31,300
6	12,500	12,500	15,000	109,000	64,300	280,000	84,400	32,600	20,200	14,600	21,900	26,900
7	11,800	11,600	14,500	132,000	49,500	309,000	96,500	28,800	19,400	14,400	18,000	21,400
8	11,000	11,800	14,500	141,000	43,500	310,000	91,000	27,800	20,800	14,000	16,400	18,100
9	11,400	11,500	14,500	129,000	42,200	266,000	95,300	27,000	28,000	13,500	14,500	16,700
10	11,500	11,500	14,000	93,400	40,300	191,000	94,700	25,800	29,300	14,100	17,000	14,800
11	12,000	11,400	16,000	65,100	38,300	123,000	81,900	25,100	29,600	15,000	20,900	14,000
12	11,900	11,400	16,700	50,800	36,200	88,000	70,900	24,400	31,000	13,600	24,100	15,500
13	12,000	12,100	16,400	43,000	33,200	82,200	64,100	23,600	30,100	13,900	20,000	14,100
14	11,700	11,900	16,400	42,600	28,800	104,000	58,300	23,400	27,800	14,600	17,800	15,200
15	11,200	12,000	16,500	48,400	28,100	113,000	55,600	23,500	26,900	15,700	16,400	14,300
16	11,200	12,400	16,400	59,300	29,500	109,000	53,500	23,400	25,000	17,000	16,400	13,200
17	11,600	13,300	16,000	62,000	31,400	100,000	52,400	22,900	23,100	51,000	19,700	12,900
18	11,200	13,000	15,300	66,400	35,400	136,000	48,000	22,300	21,500	84,500	23,000	12,100
19	13,200	12,500	13,900	63,200	52,000	151,000	44,500	21,200	22,900	65,800	23,900	12,400
20	14,800	12,400	13,200	60,700	88,400	144,000	40,700	19,700	22,800	48,600	20,100	11,900
21	16,700	12,400	13,600	55,200	123,000	129,000	38,200	18,000	25,000	44,100	17,400	11,600
22	19,600	12,300	13,800	56,600	150,000	120,000	35,500	15,900	25,200	56,800	15,500	11,600
23	23,200	12,900	15,000	91,600	144,000	117,000	32,900	15,500	22,400	74,800	15,000	11,500
24	20,700	13,100	21,100	102,000	127,000	115,000	31,100	16,800	22,600	63,100	14,900	11,500
25	17,200	13,000	24,300	101,000	104,000	154,000	29,900	18,900	21,500	51,200	20,400	12,200
26	14,800	15,300	30,500	90,000	83,400	184,000	29,100	18,300	19,600	45,400	26,400	12,500
27	14,400	14,500	31,500	72,000	82,500	191,000	27,600	19,500	17,600	41,800	20,800	12,800
28	13,600	14,200	35,400	59,600	84,800	196,000	26,500	20,000	16,600	42,500	17,200	13,400
29	13.400	14,200	75,400	49,900	....	196,000	26,000	19,500	15,800	40,600	14,800	15,500
30	12,700	14,100	103,000	61,300	....	144,000	25,700	18,900	16,200	36,200	13,400	21,700
31	13,000	....	96,300	92,900	....	113,000	....	19,600	....	30,400	12,500	....

Monthly discharge of Tennessee River at Chattanooga, Tenn., for the year ending Sept. 30, 1917.

[Drainage area, 21,400 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	23,200	11,000	13,700	0.640	0.74
November	15,300	11,400	12,800	.598	.67
December	103,000	13,200	24,800	1.16	1.34
January	141,000	42,600	75,400	3.52	4.06
February	150,000	28,100	70,300	3.29	3.43
March	310,000	78,300	163,000	7.62	8.78
April	96,500	25,700	57,100	2.67	2.98
May	33,000	15,500	23,600	1.10	1.27
June	31,000	15,800	22,900	1.07	1.19
July	84,500	13,500	32,900	1.54	1.78
August	26,700	12,500	19,400	.907	1.05
September	34,000	11,500	17,100	.799	.89
The year	310,000	11,000	44,400	2.07	28.18

TENNESSEE RIVER AT FLORENCE, ALA.

Location.—At Southern Railway bridge at lower end of Pattons Island, just below foot of Little Muscle Shoals, 1 mile south of Florence, Lauderdale County.

Drainage area.—30,800 square miles.

Records available.—November 7, 1871, to September 30, 1917.

Gage.—Rod gage consisting of four sections of steel, three-eighths inch by 7½ inches, attached to right face of stone draw pier, which has batter of 1 inch to the foot. These sections form one continuous gage, graduated from −1.92 to 33.5 feet. Zero of gage, 400.85 feet above sea level. Gage read by R. E. Coburn. For description of gages used prior to September 30, 1913, see Water-Supply Paper 353, p. 151.

Discharge measurements.—Made from downstream side of highway section (the low-level or through section) of 17-span combined railway and highway bridge. Special care necessary to counteract effect of obstruction of current by piers.

Channel and control.—Bed rocky, rough, and uneven; probably permanent. Control practically permanent.

Extremes of discharge.—Maximum stage recorded during year, 24.7 feet at 6 p. m., March 12 (discharge, 319,000 second-feet); minimum stage, 0.1 foot at 7 a. m. and 6 p. m., September 26, and 7 a. m., September 27 (discharge, 12,100 second-feet).

1871–1917: Maximum stage recorded, 32.5 feet at 10 and 12 p. m., March 19, 1897 (discharge, 499,000 second-feet); minimum stage, −0.80 foot September 18, 1878 (discharge, 7,350 second-feet).

Ice.—Stage-discharge relation not affected by ice.

Regulation.—The operation of Hales Bar lock and dam, 175 miles upstream, may cause some diurnal fluctuation in low-stage flow.

Accuracy.—Stage-discharge relation practically permanent. Rating curve well defined above 12,000 second-feet. Gage read to tenths twice daily; oftener during high water. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Cooperation.—Gage-height record furnished by Mississippi River Commission.

Discharge measurements of Tennessee River at Florence, Ala., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Oct. 17	L. J. Hall	0.30	13,800
Feb. 28	.....do	12.30	130,000
Mar. 11	W. E. Hall, L. J. Hall, and O. P. Hall	24.30	310,000
12	.....do	24.60	319,000

Daily discharge, in second-feet, of Tennessee River at Florence, Ala., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	12,600	14,100	16,800	113,000	108,000	125,000	240,000	37,800	26,200	23,200	47,100	21,800
2	12,600	14,100	16,800	112,000	140,000	154,000	234,000	36,900	27,700	20,400	42,800	21,800
3	13,600	13,600	16,800	105,000	150,000	196,000	205,000	36,000	29,300	19,800	39,400	23,200
4	13,600	13,600	17,900	97,400	146,000	250,000	163,000	40,300	29,300	20,400	36,000	29,300
5	14,600	13,600	18,500	92,600	135,000	271,000	191,000	45,400	28,500	21,800	33,500	36,000
6	14,600	13,600	19,200	98,600	114,000	279,000	208,000	49,800	28,500	21,100	32,600	37,800
7	14,600	13,600	19,800	111,000	97,400	279,000	199,000	46,200	27,700	20,400	31,000	36,000
8	14,600	13,600	19,800	125,000	84,300	285,000	178,000	42,800	27,700	20,400	30,100	32,600
9	14,600	13,600	19,200	142,000	68,300	285,000	164,000	41,200	32,600	19,200	29,300	29,300
10	14,100	13,600	18,500	150,000	62,400	295,000	152,000	37,800	48,000	17,900	28,500	27,700
11	13,600	13,600	19,200	149,000	57,000	311,000	140,000	36,000	58,800	16,800	27,700	24,600
12	13,100	13,100	19,800	126,000	53,400	317,000	129,000	34,400	53,400	16,200	26,200	21,100
13	13,100	13,100	20,400	84,300	51,600	309,000	109,000	32,600	48,000	15,600	23,900	19,200
14	12,600	12,600	20,400	73,300	49,800	295,000	99,800	31,800	43,700	15,600	24,600	17,300
15	12,600	12,600	21,100	65,300	48,000	266,000	85,400	31,000	40,300	16,800	26,200	16,800
16	13,100	12,600	20,400	62,400	48,000	221,000	76,600	31,000	39,400	15,600	25,400	16,800
17	13,600	13,100	20,400	68,300	48,900	205,000	73,300	31,000	37,800	21,800	25,400	19,200
18	14,100	13,100	19,800	76,600	51,600	205,000	70,300	30,100	33,500	31,000	24,600	17,900
19	14,100	13,100	19,800	84,300	60,600	190,000	66,300	30,100	31,000	48,000	23,900	16,800
20	14,100	13,600	19,200	90,200	106,000	175,000	62,400	29,300	29,300	85,400	24,600	16,200
21	14,600	14,100	19,200	90,200	152,000	202,000	57,900	28,500	27,700	79,900	26,200	15,600
22	15,600	13,600	19,200	92,600	166,000	212,000	53,400	27,700	26,900	70,300	26,900	14,100
23	17,300	13,600	19,200	112,000	172,000	223,000	49,800	26,900	28,500	66,300	26,200	13,600
24	19,200	13,100	19,800	124,000	178,000	234,000	48,000	26,900	31,000	78,800	24,600	13,100
25	20,400	13,600	20,400	130,000	182,000	240,000	46,200	26,200	30,100	93,800	21,800	12,600
26	23,200	14,100	22,500	135,000	175,000	240,000	42,800	24,600	27,700	90,200	19,200	12,100
27	23,200	14,100	29,300	130,000	154,000	252,000	42,000	23,900	26,900	77,700	17,900	16,800
28	20,400	14,600	53,400	114,000	133,000	253,000	41,200	23,200	26,200	66,300	20,400	26,200
29	17,300	16,800	78,800	102,000	....	250,000	39,400	24,600	24,600	59,700	26,200	26,200
30	16,200	17,900	85,400	97,400	....	250,000	38,600	23,900	23,200	57,000	26,200	25,400
31	15,600	....	97,400	92,600	....	247,000	....	24,600	....	51,600	23,200	....

Monthly discharge of Tennessee River at Florence, Ala., for the year ending Sept 30, 1917.

[Drainage area, 30,800 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	23,200	12,600	15,400	0.500	0.58
November	17,900	12,600	13,800	.448	.50
December	97,400	16,800	27,400	.890	1.03
January	150,000	62,400	105,000	3.41	3.93
February	182,000	48,000	107,000	3.47	3.61
March	317,000	125,000	242,000	7.86	9.06
April	240,000	38,600	110,000	3.57	3.98
May	49,800	23,200	32,700	1.06	1.22
June	58,800	23,200	33,100	1.07	1.19
July	93,800	15,600	41,300	1.34	1.54
August	47,100	17,900	27,800	.903	1.04
September	37,800	12,100	21,900	.711	.79
The year	317,000	12,100	64,700	2.10	28.47

TENNESSEE RIVER AT JOHNSONVILLE, TENN.[1]

LOCATION.—At Nashville, Chattanooga & St. Louis Railway freight elevator, about 1,000 feet below railway bridge at Johnsonville, Humphreys County, 96 miles from mouth of Tennessee River and 160 miles below Florence, Ala.

DRAINAGE AREA.—38,500 square miles.

RECORDS AVAILABLE.—October 1, 1875, to September 30, 1917. Records from October 1, 1875, to September 30, 1913, published in Water-Supply Paper 353.

[1] For detailed history of this station see Water-Supply Paper 353, pp. 195-201.

GAGE.—Staff at freight elevator on right bank, about 1,000 feet below the Nashville, Chattanooga & St. Louis Railway bridge.

DISCHARGE MEASUREMENTS.—Made from downstream and upstream side of through railway bridge of six spans and draw span.

CHANNEL AND CONTROL.—No information concerning control. Channel at measuring section at bridge composed of boulders and coarse gravel; apparently permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 38.9 feet March 18, caused partly by backwater from the Ohio River; minimum stage, 1.3 feet November 16–20 (discharge, 13,400 second-feet).

The highest unquestioned record of stage is 48 feet March 24, 1897.

ICE.—Stage-discharge relation not materially affected by ice.

ACCURACY.—Stage-discharge relation is considered permanent except for effect of backwater from Ohio River. No discharge measurements made at this station since August 1, 1914. Not affected by ice during the year. Rating curve well defined between discharges 9,370 and 302,000 second-feet. Gage read once daily to tenths. Daily discharge ascertained by applying daily gage heights to rating table except for period when flow was affected by backwater from Ohio River (see footnote to table of daily discharge). Records good except those estimated which are fair.

COOPERATION.—Gage-height record furnished by United States Weather Bureau.

No discharge measurements were made at this station during the year.

Daily discharge, in second-feet, of Tennessee River at Johnsonville, Tenn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	14,500	17,800	17,400			185,000		42,500	31,000	27,700	62,800	26,500
2	14,500	16,500	17,800					41,800	34,200	25,900	57,300	25,300
3	14,500	16,100	17,800		160,000			40,400	37,000	24,700	52,000	24,100
4	14,800	15,200	17,800					38,300	39,000	23,500	46,100	24,100
5	14,800	15,200	17,800					43,200	37,600	22,900	41,800	25,300
6	15,200	15,200	18,300		166,000			46,800	34,900	23,500	39,700	28,400
7	15,600	15,200	19,700		156,000			50,500	34,200	24,100	36,300	34,200
8	16,100	15,600	20,700		138,000			50,500	39,000	24,100	34,200	36,300
9	15,600	15,600	20,700		117,000			47,600	48,300	23,500	32,900	37,000
10	15,600	15,200	21,300	120,000	99,300		168,000	44,700	64,400	21,800	31,600	34,200
11	15,600	15,200	21,300		78,600			42,500	75,200	21,300	31,000	31,000
12	15,600	14,500	21,300		70,200			40,400	79,500	20,700	30,300	29,000
13	14,800	13,700	21,300		70,200			38,300	78,600	19,700	29,000	25,900
14	14,500	13,700	21,800		60,400			37,000	71,000	18,700	25,900	22,400
15	14,100	13,700	21,800		57,300			36,300	61,200	17,400	24,100	20,700
16	13,700	13,400	21,800		58,800	291,000		35,600	52,800	18,700	25,300	19,200
17	13,700	13,400	21,800		59,600			34,900	48,300	20,700	27,700	19,200
18	14,100	13,400	21,800		60,400			34,200	44,700	20,700	27,700	19,200
19	15,200	13,400	21,800	88,900	60,400			32,900	40,400	23,500	26,500	20,200
20	15,200	13,400	21,300	95,800	65,200			32,200	37,000	33,600	25,900	19,700
21	15,200	13,700	21,300	105,000	90,600		77,800	31,600	33,600	61,200	25,900	18,700
22	15,200	14,500	20,700	133,000	135,000		71,000	31,600	32,900	89,800	25,900	17,800
23	15,200	14,800	20,700	150,000	167,000		65,200	32,200	30,300	93,200	27,700	16,900
24	16,100	15,200	23,500	163,000	180,000		61,200	32,200	29,600	94,100	27,700	15,600
25	17,400	15,200	24,100	168,000	185,000		53,500	31,600	31,000	95,800	27,700	15,600
26	18,700	14,800	24,100		192,000		53,500	30,300	30,300	103,000	25,900	15,200
27	20,200	14,800	24,100		194,000		50,500	30,300	29,600	107,000	23,500	14,500
28	22,400	15,200	34,200	132,000	193,000		47,600	31,000	29,600	102,000	21,800	14,100
29	23,500	15,600	64,400		....		46,100	29,600	29,600	92,400	21,300	18,300
30	21,300	16,100	98,400		....		44,700	29,000	29,000	83,800	23,500	32,200
31	19,200	....	117,000		....		....	29,000	....	71,000	25,900	....

NOTE.—Daily discharge estimated, because of backwater effect from Ohio River, from the flow at Florence as follows: Jan. 1-18, 26-31: Feb. 1-5: Mar. 2-31: Apr. 1-20. Braced quantities are the estimated means for the indicated periods.

Monthly discharge of Tennessee River at Johnsonville, Tenn., for the year ending Sept. 30, 1917.

[Drainage area, 38,500 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	23,500	13,700	16,200	0.421	0.49
November	17,800	13,400	14,800	.384	.43
December	117,000	17,400	28,300	.735	.85
January			124,000	3.22	3.71
February			123,000	3.19	3.32
March			288,000	7.48	8.62
April			131,000	3.40	3.79
May	50,500	29,000	37,100	.964	1.11
June	79,500	29,000	43,100	1.12	1.25
July	107,000	17,400	46,800	1.22	1.41
August	62,800	21,300	31,800	.826	.95
September	37,000	14,100	23,400	.608	.68
The period		13,400	75,500	1.96	26.61

SOUTH FORK OF HOLSTON RIVER AT BLUFF CITY, TENN.

Location.—At highway bridge at Bluff City, Sullivan County, 300 feet below Virginia & Southwestern Railway bridge, 1 mile below mouth of Indian Creek, and about 10 miles upstream from mouth of Watauga River.

Drainage area.—828 square miles.

Records available.—July 17, 1900, to September 30, 1917.

Gage.—Vertical staff attached to downstream side of bridge pier, nearest the right bank.

Discharge measurements.—Made from downstream side of bridge; also from railroad bridge 300 feet above where the section is much better except at low stages when the current becomes sluggish.

Channel and control.—Bed of river very rough. Control consists of a shallow ledge; probably permanent. Depth and velocity of current very irregular.

Extremes of discharge.—Maximum stage recorded during year, 9.3 feet at noon, March 5 (discharge, 15,600 second-feet); minimum stage recorded zero, August 28 and 29 (discharge, 185 second-feet).

1900–1917: Maximum stage recorded, 11.45 feet February 28, 1902 (discharge, 33,000 second-feet); minimum stage recorded, −0.1 foot October 16–19, 21–25, 26, 28–31, and November 1, 1904 (discharge, 150 second-feet).

Ice.—Stage-discharge relation not affected by ice.

Regulation.—Some diurnal fluctuation caused by operation of small mills upstream.

Accuracy.—Stage-discharge relation practically permanent. Rating curve fairly well defined below 25,700 second-feet. Gage read to tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good, except those for stages below 800 second-feet, which are only fair, owing to lack of discharge measurements for checking the rating curve at low water.

Cooperation.—Gage-height record furnished by United States Weather Bureau.

Daily discharge, in second-feet, of South Fork of Holston River at Bluff City, Tenn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	590	420	590	1,680	3,040	2,900	1,790	1,380	650	475	530	370
2	475	370	530	1,190	2,760	7,410	1,680	1,380	715	420	650	370
3	420	325	475	1,280	2,250	7,200	1,580	1,190	650	370	530	325
4	420	325	475	6,180	2,010	8,490	1,480	1,020	715	370	530	325
5	370	370	475	8,720	1,790	14,200	1,900	1,020	715	420	420	285
6	370	370	475	8,050	1,580	7,410	4,560	1,020	590	370	370	245
7	370	325	420	5,080	1,580	4,900	3,610	860	590	370	325	212
8	325	325	370	3,610	1,480	3,760	2,760	1,020	530	420	325	245
9	325	325	370	2,630	1,480	3,320	2,500	1,280	590	590	370	940
10	530	370	420	2,250	1,190	2,760	2,130	1,380	785	420	420	785
11	530	370	420	1,790	1,190	2,500	1,900	1,280	1,020	370	420	475
12	475	370	475	1,580	1,100	2,370	1,680	1,380	940	370	370	370
13	420	370	475	1,380	1,020	5,440	1,680	1,280	785	420	325	325
14	370	420	530	1,580	1,020	4,220	1,900	1,190	650	370	325	285
15	370	420	590	2,130	1,020	3,760	1,580	1,100	3,180	785	325	285
16	420	420	420	2,010	1,280	3,040	1,480	1,020	1,480	1,280	530	285
17	420	420	370	1,790	1,380	5,440	1,380	860	1,020	2,010	590	245
18	715	370	420	1,790	1,900	7,410	1,280	785	940	1,100	530	245
19	530	370	420	1,790	2,010	4,730	1,190	650	785	860	420	285
20	650	325	530	1,790	3,460	3,460	1,190	650	715	715	370	245
21	650	325	590	1,580	5,260	2,900	1,100	650	650	650	370	245
22	590	325	1,020	6,380	3,460	3,040	1,020	650	590	715	325	212
23	590	325	1,380	6,780	2,500	2,500	1,020	715	590	1,580	370	245
24	530	370	1,280	3,760	4,560	5,990	940	785	530	1,380	325	212
25	530	420	1,100	2,760	5,260	7,830	940	650	420	1,680	325	212
26	475	370	940	2,250	3,460	4,560	940	650	475	1,900	285	212
27	420	325	715	1,900	2,900	3,610	860	590	420	1,900	245	212
28	370	370	860	1,480	2,370	3,040	860	2,010	785	1,190	185	475
29	370	370	6,580	2,010	....	2,500	860	1,020	590	860	185	475
30	370	650	3,320	4,900	....	2,250	860	860	590	715	245	370
31	420	....	1,680	3,610	....	2,010	....	785	....	650	325	....

Monthly discharge of South Fork of Holston River at Bluff City, Tenn., for the year ending Sept. 30, 1917.

[Drainage area, 828 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	715	325	465	0.562	0.65
November	650	325	374	.452	.50
December	6,580	370	926	1.12	1.29
January	8,720	1,190	3,090	3.73	4.30
February	5,260	1,020	2,300	2.78	2.90
March	14,200	2,010	4,680	5.65	6.51
April	4,560	860	1,620	1.96	2.19
May	2,010	590	1,000	1.21	1.40
June	3,180	420	790	.954	1.06
July	2,010	370	830	1.00	1.15
August	650	185	383	.463	.53
September	940	212	334	.403	.45
The year	14,200	185	1,400	1.69	22.93

HOLSTON RIVER NEAR ROGERSVILLE, TENN.

LOCATION.—At Virginia & Southwestern Railway bridge near Austin Mill, Hawkins County, half a mile below new county highway bridge, 2 miles downstream from mouth of Dodson Creek, 3 miles south of Rogersville, and 11 miles northeast of Bulls Gap, Tenn.

DRAINAGE AREA.—3,060 square miles.

RECORDS AVAILABLE.—March 10, 1902 (daily discharge record beginning January 1, 1904) to September 30, 1917.

GAGE.—Vertical staff attached to right side of bridge pier nearest the right bank.

DISCHARGE MEASUREMENTS.—Made from the steel highway bridge, about half a mile upstream from gage.

CHANNEL AND CONTROL.—Bed of stream composed of solid rock, boulders and gravel. Right bank high and not subject to overflow; left bank high, but subject to overflow at extremely high stages. Control formed by rock shoals below bridge; practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 17.1 feet at 8 a. m. March 5 (discharge, 56,300 second-feet); minimum stage recorded, 1.4 feet at 8 a. m., November 9, 10, December 18, and September 17–27 (discharge, 850 second-feet).

1904–1917: Maximum stage recorded, 19.1 feet, March 28, 1913 (discharge, about 67,000 second-feet); minimum stage recorded, 1.0 foot October 23 to November 3, 1904 (discharge, 490 second-feet).

ICE.—Stage-discharge relation not affected by ice.

REGULATION.—Operation of power plants a long distance upstream causes some diurnal fluctuations in stage.

ACCURACY.—Stage-discharge relation practically permanent; not affected by ice. Rating curve well defined below 33,000 second-feet; extended above that point. Gage read to tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records fair.

Discharge measurements of Holston River near Rogersville, Tenn., during the year ending Sept. 30, 1917.

[Made by L. J. Hall.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Oct. 28	1.59	1,120
Dec. 14	1.94	1,800
Mar. 3	10.78	32,200

Daily discharge, in second-feet, of Holston River near Rogersville, Tenn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,780	1,570	1,570	5,630	9,850	11,700	6,840	4,500	1,950	1,760	2,350	1,570
2	1,950	1,570	1,950	4,230	9,850	31,200	6,230	4,770	1,950	1,570	1,950	1,950
3	1,570	1,390	1,760	4,500	9,140	33,100	5,930	4,500	2,150	1,570	2,350	1,760
4	1,570	1,390	1,760	15,400	6,840	40,700	5,340	3,720	2,150	1,570	1,950	1,390
5	1,390	1,210	1,760	26,600	6,230	56,300	5,930	3,470	2,150	1,570	1,950	1,210
6	1,210	1,210	1,760	33,100	5,980	36,900	10,200	3,470	1,950	1,390	1,760	1,030
7	1,030	1,030	1,760	21,700	5,980	19,100	11,300	3,230	1,760	1,390	1,570	1,030
8	1,030	1,030	1,760	12,800	5,580	14,300	9,140	3,230	1,760	1,210	1,570	1,030
9	1,210	850	1,570	9,140	9,850	12,100	8,460	3,470	1,760	1,950	1,570	1,030
10	1,210	850	1,570	7,150	4,500	9,850	7,790	4,230	1,950	1,760	1,950	3,000
11	1,030	1,030	1,760	5,930	3,970	8,460	6,840	4,230	2,780	1,760	1,760	2,150
12	1,210	1,030	1,760	5,340	3,970	8,120	5,930	4,230	2,780	1,570	1,570	1,760
13	1,210	1,210	1,760	4,230	3,230	16,900	6,230	4,500	2,350	1,570	1,570	1,570
14	1,210	1,030	1,950	4,500	3,000	15,000	6,530	3,970	1,950	1,570	1,390	1,210
15	1,030	1,390	1,760	5,050	3,470	13,600	6,230	3,720	2,560	1,760	1,390	1,030
16	1,030	1,390	2,350	5,930	3,970	10,600	5,340	3,470	6,230	3,970	1,390	1,030
17	1,030	1,390	1,390	5,630	5,050	17,600	4,770	3,000	3,970	7,470	1,950	850
18	1,210	1,210	850	5,050	5,340	25,900	4,500	2,780	2,780	6,230	2,150	850
19	2,150	1,210	1,390	5,050	7,150	18,000	4,230	2,780	2,560	4,230	1,570	850
20	1,950	1,210	1,950	4,770	13,600	12,400	3,970	2,560	2,150	3,970	1,570	850
21	2,780	1,210	1,950	4,770	21,000	10,200	3,720	2,350	2,150	2,560	1,390	850
22	2,150	1,030	2,780	10,600	14,300	10,600	3,720	2,150	2,150	2,560	1,210	850
23	1,760	1,030	5,340	22,[illegible]00	9,850	9,140	3,720	2,350	1,950	2,560	5,930	850
24	1,760	1,210	5,630	13,600	15,400	17,600	3,470	2,350	1,950	5,340	1,950	850
25	1,570	1,390	3,970	9,140	19,100	29,700	3,230	2,350	1,760	5,050	1,760	850
26	1,390	1,760	3,000	7,470	13,900	18,400	3,000	2,150	1,760	6,530	1,760	850
27	1,390	1,760	2,780	6,530	10,200	13,200	3,000	1,950	1,570	5,050	1,390	850
28	1,390	1,390	5,340	5,630	8,120	12,100	3,000	1,950	1,570	3,970	1,390	1,210
29	1,210	1,570	16,100	8,800	....	9,490	3,000	3,230	2,350	4,230	1,210	1,950
30	1,390	1,390	13,900	17,200	....	7,790	3,230	2,560	1,950	3,470	1,030	1,760
31	1,390	....	7,470	12,400	....	7,150	....	2,150	....	2,560	1,390	....

NOTE.—Discharge, Feb. 6–8, estimated by comparison with records of flow for South Fork of Holston River at Bluff City, Tenn.

Monthly discharge of Holston River near Rogersville, Tenn., for the year ending Sept. 30, 1917.

[Drainage area, 3,060 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	2,780	1,030	1,490	0.487	0.56
November	1,760	850	1,260	.412	.46
December	16,100	850	3,300	1.08	1.24
January	33,100	4,230	10,000	3.27	3.77
February	21,000	3,000	8,520	2.78	2.90
March	56,300	7,150	18,000	5.88	6.78
April	11,300	3,000	5,490	1.79	2.00
May	4,770	1,950	3,210	1.05	1.21
June	6,230	1,570	2,290	.748	.83
July	7,470	1,210	3,020	.987	1.14
August	5,930	1,030	1,800	.588	.68
September	3,000	850	1,270	.415	.46
The year	56,300	850	4,970	1.62	22.03

LITTLE TENNESSEE RIVER AT JUDSON, N. C.

LOCATION.—At footbridge near Southern Railway Station at Judson, Swain County.

DRAINAGE AREA.—668 square miles (measured by Knoxville Power Co. on topographic maps).

RECORDS AVAILABLE.—April 16, 1912, to September 30, 1915; January 1, 1916, to September 30, 1917; June 25, 1896, to September 30, 1913, at old station of Geological Survey at Southern Railway bridge.

GAGE.—Friez water-stage recorder about 500 feet below footbridge.

CHANNEL AND CONTROL.—Practically permanent.

EXTREMES OF DISCHARGE.—Maximum mean daily discharge during year, 23,000 second-feet, March 4; minimum mean daily stage, 17.53 feet, August 29 (discharge, 602 second-feet).

1892–1912: Maximum stage recorded (old Geological Survey station) 13.92 feet, December 29, 1901 (discharge, 57,500 second-feet); minimum stage recorded 2.10 feet, October 13 to November 1 and December 20, 1904 (discharge, 275 second-feet).

1913–1917: Maximum mean daily discharge (Knoxville Power Co.'s station), 23,000 second-feet March 4, 1917; minimum mean daily stage recorded, 17.1 feet, September 17, October 1 and 2, 1914 (discharge, 380 second-feet).

ICE.—Stage-discharge relation not affected by ice.

COOPERATION.—Daily discharge record furnished by Knoxville Power Co.

Daily discharge, in second-feet, of Little Tennessee River at Judson, N. C., for the years ending Sept. 30, 1916 and 1917.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1916.									
1	3,468	5,508	1,823	1,104	1,048	1,149	1,216	2,416	1,008
2	3,202	8,874	2,416	1,279	1,024	1,326	1,270	2,966	1,120
3	2,922	7,587	2,680	1,459	1,016	1,402	1,261	2,636	1,146
4	2,647	6,033	2,328	1,656	1,072	1,384	1,146	2,383	1,032
5	2,482	3,662	2,086	1,421	1,032	1,497	1,104	2,889	970
6	2,757	3,373	1,987	1,586	985	1,440	1,048	2,526	963
7	2,856	3,054	2,207	1,507	925	3,166	1,080	2,636	940
8	2,801	2,801	2,229	1,921	910	2,086	2,394	2,229	925
9	2,559	2,680	1,932	1,866	880	1,586	10,228	2,471	1,000
10	2,383	2,702	1,855	1,697	875	1,449	14,980	2,372	1,280
11	2,416	2,448	1,781	1,636	868	1,478	11,840	2,229	1,180
12	2,361	2,328	1,676	1,556	861	2,042	7,986	2,042	940
13	3,440	2,372	1,626	1,488	1,032	1,987	5,676	1,950	889
14	3,262	2,251	1,586	1,431	1,048	1,844	4,226	1,873	896
15	2,801	2,108	1,606	1,374	868	2,394	3,426	1,775	955
16	2,757	2,042	1,497	1,336	840	2,768	6,390	1,700	882
17	2,680	2,009	1,440	1,440	847	2,713	7,944	1,660	840
18	2,529	1,976	1,412	1,317	847	2,108	5,067	1,850	819
19	2,529	1,823	1,412	1,252	917	1,791	4,563	1,650	903
20	2,462	1,770	1,364	1,225	903	1,707	5,466	1,450	896
21	2,448	1,739	1,440	1,364	875	1,707	5,991	1,402	868
22	3,528	1,666	1,393	1,279	1,297	1,440	5,046	1,355	868
23	3,584	1,707	1,317	1,216	7,814	1,326	5,613	1,355	770
24	2,911	1,932	1,279	1,198	7,052	1,656	4,500	1,383	742
25	2,658	1,910	1,279	1,252	3,442	1,866	4,245	1,450	721
26	2,570	1,686	1,317	1,207	2,536	1,536	3,496	1,146	714
27	2,658	1,616	1,954	1,180	2,065	1,469	3,840	1,137	700
28	2,625	1,596	1,686	1,138	1,770	1,345	3,282	1,112	700
29	2,427	1,718	1,497	1,121	1,739	1,326	2,966	1,112	1,760
30	2,273	....	1,412	1,080	1,976	1,326	2,724	1,129	970
31	2,350	....	1,355	....	1,739	....	2,559	1,040	....

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1916-17.												
1	819	955	1,080	1,686	2,559	5,676	3,509	1,976	1,225	925	1,040	3,142
2	784	721	978	1,596	2,207	4,836	3,386	1,666	1,770	889	1,298	1,910
3	749	763	910	2,317	2,174	9,367	3,142	1,556	1,298	882	1,154	1,760
4	735	770	882	2,944	2,174	23,000	3,032	1,760	1,207	910	1,008	1,279
5	721	749	1,040	3,010	2,119	11,766	5,802	1,770	1,080	847	....	1,032
6	756	735	940	3,510	2,064	8,196	5,214	1,566	1,024	847	....	889
7	735	721	875	2,713	2,250	6,096	4,046	1,536	1,138	840	910	910
8	693	707	882	2,284	2,174	3,466	3,678	1,606	1,374	903	940	875
9	714	700	1,718	2,009	1,844	4,226	3,468	1,478	1,823	798	....	889
10	798	784	1,478	1,802	1,606	3,652	3,098	1,440	2,537	756	1,171	847
11	721	728	1,243	1,680	1,636	3,482	2,933	1,402	1,760	742	889	770
12	686	721	1,225	1,487	1,536	3,286	2,801	1,374	1,440	728	805	735
13	673	812	1,100	1,487	1,469	3,228	2,867	1,307	1,279	728	770	707
14	666	985	1,010	2,944	1,440	3,286	2,658	1,279	1,307	714	749	707
15	666	1,000	1,000	2,504	1,954	2,955	2,482	1,270	1,364	728	784	700
16	700	860	805	3,412	1,739	2,856	2,372	1,234	1,146	728	819	875
17	714	812	....	2,944	1,586	3,599	2,284	1,216	1,000	861	854	770
18	756	784	....	2,669	3,286	3,554	2,229	1,180	978	970	714	779
19	1,540	749	....	2,581	3,440	3,043	2,141	1,146	1,279	1,048	673	660
20	1,540	735	....	2,306	7,776	2,944	2,075	1,112	1,440	1,048	798	634
21	1,030	721	....	2,252	6,516	3,482	2,042	1,096	1,288	1,326	666	647
22	819	721	1,596	3,823	3,959	3,454	1,976	1,129	1,412	2,460	634	854
23	749	1,146	1,383	2,944	3,874	3,524	1,910	1,636	1,104	1,516	647	1,104
24	721	1,459	1,198	2,614	4,322	....	1,866	1,180	1,024	1,345	686	826
25	693	1,064	1,129	2,284	3,310	....	1,823	1,112	940	1,120	647	749
26	673	889	1,080	2,251	2,944	6,852	1,888	1,216	903	1,008	621	700
27	647	847	1,137	2,086	2,779	9,433	1,760	1,252	925	948	615	840
28	634	861	2,944	1,899	2,614	7,146	1,697	1,279	1,104	925	608	3,142
29	647	1,171	3,087	2,449	....	5,508	1,760	1,189	1,421	861	602	1,616
30	1,355	1,243	2,185	2,339	....	4,500	1,749	1,064	1,040	847	647	1,207
31	1,270	....	1,770	2,086	....	3,942	....	1,088	....	947	1,791	....

Monthly discharge of Little Tennessee River at Judson, N. C., for the years ending Sept. 30, 1916 and 1917.

[Drainage area, 668 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1916.					
January	3,580	2,270	2,750	4.12	4.75
February	8,870	1,600	2,860	4.28	4.62
March	2,680	1,280	1,710	2.56	2.95
April	1,920	1,080	1,390	2.08	2.32
May	7,810	840	1,650	2.47	2.85
June	3,170	1,330	1,750	2.62	2.92
July	15,000	1,050	4,600	6.89	7.94
August	2,970	1,040	1,850	2.77	3.19
September	1,760	700	947	1.42	1.58
1916-17.					
October	1,540	634	819	1.23	1.42
November	1,460	700	864	1.29	1.44
January	3,820	1,490	2,420	3.62	4.17
February	7,780	1,440	2,760	4.13	4.30
March	23,000	2,860	....	....	....
April	5,800	1,700	2,730	4.09	4.56
May	1,980	1,060	1,360	2.04	2.35
June	2,540	903	1,290	1.93	2.15
July	2,460	714	974	1.46	1.68
August	....	602	....	....	....
September	3,140	634	1,090	1.63	1.82
The year	23,000	602	....	....	....

NOTE.—Monthly discharge computed by engineers of the Geological Survey from daily discharge record furnished by the Knoxville Power Co.

TUCKASEGEE RIVER AT BRYSON, N. C.

Location.—At highway bridge in Bryson, Swain County, half a mile below mouth of Deep Creek and about 15 miles above junction of Tuckasegee River with Little Tennessee River.

Drainage area.—673 square miles (measured by Knoxville Power Co. on topographic maps).

Records available.—November 7, 1897, to September 30, 1915; January 1, 1916, to September 30, 1917.

Gage.—Friez water-stage recorder, installed February 3, 1914 by the Knoxville Power Co., about 200 feet below the bridge to which old staff gage of the Geological Survey was attached. The old staff gage was used prior to installation of Friez gage.

Discharge measurements.—Made from downstream side of bridge.

Channel and control.—Bed probably changes slightly after each flood, but conditions quickly become normal. Control composed of boulders; practically permanent.

Extremes of discharge.—Maximum mean daily stage recorded during year, 10.7 feet March 4 (discharge, 23,200 second-feet); minimum mean daily stage, 1.22 feet November 8 and 9 (discharge, 616 second-feet).

1898–1917: Maximum stage recorded, 11.0 feet (old Geological Survey gage) March 19, 1899 (discharge, 38,600 second-feet); minimum discharge recorded, 300 second-feet several days in September, October, and November, 1899, and August 25, 1902.

Ice.—Stage-discharge relation not affected by ice.

Cooperation.—Daily-discharge record furnished by the Knoxville Power Co.

Daily discharge, in second-feet, of Tuckasegee River at Bryson, N. C., for the years ending Sept. 30, 1916 and 1917.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1916.									
1	3,711	5,020	1,646	1,454	....	1,440	1,454	1,958	1,148
2	3,235	7,111	2,168	1,454	....	1,333	1,481	2,402	1,175
3	3,099	5,105	2,555	1,604	....	1,454	1,646	2,334	1,241
4	2,776	3,966	2,119	1,746	....	1,333	1,333	2,300	1,135
5	2,589	3,405	1,943	1,563	....	1,214	1,254	2,912	1,109
6	2,912	3,065	1,943	1,805	....	1,481	1,188	2,300	1,122
7	3,813	2,878	2,623	1,646	....	2,912	1,188	2,521	1,083
8	3,371	2,623	2,555	2,006	....	1,660	1,835	2,201	1,109
9	2,895	2,640	2,086	1,866	....	1,413	6,737	2,022	1,280
10	2,691	2,504	1,974	1,646	....	1,320	7,145	1,974	1,280
11	2,589	2,250	1,866	1,632	....	1,387	5,598	1,881	1,346
12	2,521	2,184	1,775	1,618	....	2,623	4,034	1,618	1,083
13	3,507	2,250	1,761	1,660	....	1,990	3,082	1,927	1,018
14	2,861	2,022	1,746	1,563	1,005	1,590	2,674	2,038	1,044
15	2,521	1,912	1,881	1,494	927	2,912	2,504	1,776	1,122
16	2,521	1,866	1,688	1,427	876	3,099	3,694	1,660	1,044
17	2,725	1,835	1,604	1,481	889	2,963	4,765	1,805	1,018
18	3,813	1,776	1,590	1,333	876	2,151	3,660	1,820	1,031
19	2,691	1,660	1,590	1,293	940	1,850	3,456	1,576	966
20	2,555	1,632	1,549	1,241	876	1,761	4,408	1,494	927
21	2,521	1,576	1,732	1,360	839	1,703	4,901	1,427	876
22	2,521	1,535	1,660	1,254	1,307	1,508	4,119	1,400	814
23	2,657	1,563	1,535	1,188	5,615	1,427	3,609	1,400	779
24	2,487	1,791	1,454	....	3,762	1,850	3,235	1,373	721
25	2,267	1,850	1,440	....	2,167	1,943	3,320	1,307	689
26	2,317	1,563	1,494	....	1,703	1,590	2,878	1,280	678
27	2,487	1,535	2,283	....	1,440	1,467	2,844	1,241	678
28	2,402	1,563	1,866	....	1,481	1,373	2,521	1,214	678
29	2,217	1,632	1,646	....	1,618	1,387	2,402	1,201	1,563
30	2,054	....	1,563	....	2,151	1,333	2,135	1,346	889
31	2,119	....	1,508	....	1,761	....	2,038	1,201	....

Daily discharge, in second-feet, of Tuckasegee River at Bryson, N. C., for the years ending Sept. 30, 1916 and 1917—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1916-7.												
1	733	744	1,214	1,688	4,595	5,260	3,541	2,086	1,227	1,044	1,161	2,844
2	678	689	1,057	1,549	3,218	4,510	3,320	1,746	1,333	979	1,467	1,632
3	668	678	979	4,306	2,742	9,380	3,099	1,674	1,161	1,031	1,660	1,703
4	657	647	966	4,255	2,417	23,180	2,946	1,927	1,188	1,018	1,229	1,333
5	668	657	1,241	3,082	2,007	9,980	3,218	1,805	1,096	966	1,096	1,148
6	699	647	1,109	3,184	1,974	6,295	4,391	1,646	1,070	927	992	1,044
7	668	626	992	2,436	1,820	5,068	3,745	1,646	1,267	1,083	1,070	966
8	668	616	966	2,103	1,788	4,850	3,626	1,732	1,413	1,173	1,135	914
9	689	616	1,674	1,866	1,746	4,055	3,541	1,618	1,912	953	1,175	889
10	733	721	1,360	1,703	1,467	3,725	3,201	1,590	2,470	889	1,109	863
11	699	647	1,161	1,578	1,522	3,336	2,980	1,563	1,618	889	979	839
12	668	626	1,188	1,347	1,388	3,558	2,861	1,618	1,400	826	902	814
13	657	841	1,031	1,413	1,333	3,575	3,133	1,549	1,290	839	889	779
14	647	1,096	....	3,524	1,333	3,490	2,776	1,521	1,467	802	863	767
15	647	966	....	2,385	1,834	3,201	2,572	1,481	1,413	1,214	1,057	767
16	1,031	814	....	3,439	1,535	3,048	2,453	1,440	1,188	1,280	1,188	779
17	779	755	1,018	2,696	1,467	4,187	2,351	1,400	1,135	1,267	1,031	791
18	814	744	....	2,623	3,320	3,728	2,283	1,360	1,057	1,508	902	755
19	2,385	710	....	2,523	3,942	3,320	2,234	1,333	1,227	1,508	826	733
20	1,387	710	....	2,167	6,380	3,065	2,168	1,307	1,346	1,440	863	721
21	1,044	699	1,057	2,086	4,467	3,779	2,119	1,280	1,241	1,896	889	733
22	901	688	1,576	6,706	3,422	3,371	2,070	1,320	1,373	2,470	814	940
23	839	1,135	1,267	3,162	3,012	3,371	2,006	1,549	1,135	1,850	814	927
24	790	1,400	1,148	2,674	3,878	7,955	1,958	1,293	1,109	1,731	814	837
25	755	927	1,096	2,351	3,081	5,496	1,896	1,214	1,070	1,494	721	802
26	721	839	1,070	2,070	2,793	4,952	2,070	1,254	1,005	1,508	688	755
27	710	839	1,400	1,846	2,735	7,026	1,850	1,293	1,005	1,467	668	876
28	678	876	4,935	1,702	2,334	5,547	1,790	1,453	1,148	1,604	657	2,691
29	721	1,241	3,490	2,810	....	4,748	2,135	1,320	1,508	1,333	668	1,373
30	1,096	1,400	2,267	2,317	....	4,187	1,990	1,201	1,214	1,201	721	1,083
31	901	....	1,790	2,030	....	3,796	....	1,175	....	1,175	1,494	....

Monthly discharge of Tuckasegee River at Bryson, N. C., for the years ending Sept. 30, 1916 and 1917.

[Drainage area, 673 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1916.					
January	3,810	2,050	2,760	4.10	4.73
February	7,110	1,540	2,490	3.70	3.99
March	2,620	1,440	1,830	2.72	3.14
April 1-23	2,010	1,190	1,540	2.29	1.96
May 14-31	5,620	839	1,680	2.50	1.67
June	3,100	1,210	1,780	2.64	2.94
July	7,140	1,190	3,130	4.65	5.36
August	2,910	1,200	1,770	2.63	3.03
September	1,560	678	1,020	1.52	1.70
1916-17.					
October	2,380	647	830	1.23	1.42
November	1,400	616	820	1.22	1.36
January	6,710	1,350	2,570	3.82	4.40
February	6,380	1,330	2,630	3.91	4.07
March	23,200	3,050	5,320	7.90	9.11
April	4,390	1,790	2,680	3.98	4.44
May	2,090	1,180	1,500	2.23	2.57
June	2,470	1,000	1,300	1.93	2.15
July	2,470	802	1,270	1.89	2.18
August	1,660	657	985	1.46	1.68
September	2,840	721	1,070	1.59	1.77

NOTE.—Monthly discharge computed by engineers of U. S. Geol. Survey from daily-discharge records furnished by Knoxville Power Co.

HIWASSEE RIVER AT MURPHY, N. C.

LOCATION.—At highway bridge 100 feet upstream from Louisville & Nashville Railroad bridge, 300 feet from railroad station, which is on right side of river, four blocks from Murphy post office, Cherokee County, and half a mile upstream from mouth of Valley River.

DRAINAGE AREA.—410 square miles.

RECORDS AVAILABLE.—June 26, 1896, to August 8, 1897; October 19, 1897, to June 30, 1917.

GAGE.—Chain gage attached to downstream side of bridge; read by Miss Willie Mingus.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge.

CHANNEL AND CONTROL.—At gage the bed is mostly solid rock, and river is confined by masonry bridge abutments. Below gage the bed of stream is composed largely of sand and gravel. Low-water control is formed by a gravel and boulder riffle; high-water control is formed partly by masonry piers of railroad bridge and the riffles below. Control is changeable, owing to shifting of material that forms upper riffle.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 14.7 feet at noon, March 4 (discharge, 19,700 second-feet); minimum stage recorded, 5.2 feet at 7 a. m. October 13-18, 28 and 29 (discharge, 375 second-feet).

1896-1917: Maximum stage recorded, 18.4 feet March 19, 1899 (discharge, 22,400 second-feet); minimum stage recorded, 4.8 feet September 18, 1914 (discharge, 140 second-feet).

ICE.—Stage-discharge relation not affected by ice.

REGULATION.—Negligible.

ACCURACY.—Stage-discharge relation practically permanent during year. Rating curve fairly well defined below 3,700 second-feet. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records fair.

Discharge measurements of Hiwassee River at Murphy, N. C., during the year ending Sept. 30, 1917.

[Made by L. J. Hall.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Oct. 4	5.28	426
Dec. 13	5.73	787
Feb. 12	5.90	979

Daily discharge, in second-feet, of Hiwassee River at Murphy, N. C., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.
1	510	590	590	850	4,100	2,580	2,000	1,390	850
2	475	510	550	1,080	2,130	3,310	2,270	1,210	1,300
3	440	475	550	985	1,670	6,190	1,770	1,080	940
4	440	440	550	2,270	1,480	15,000	1,770	1,120	985
5	440	440	590	1,570	1,390	9,700	3,310	1,300	805
6	440	408	550	1,880	1,300	4,500	3,310	1,210	760
7	408	408	510	1,570	1,210	3,310	2,580	1,120	760
8	408	408	510	1,300	1,210	2,930	2,130	1,210	760
9	408	440	1,210	1,210	1,210	2,270	2,130	1,080	1,030
10	408	440	895	1,030	1,030	2,000	1,880	1,030	1,880
11	408	440	760	985	1,030	1,880	1,770	1,030	1,120
12	408	408	760	850	985	1,770	1,670	1,030	985
13	375	510	670	850	940	1,880	1,770	940	895
14	375	670	590	1,480	895	1,770	1,570	940	805
15	375	715	630	1,120	1,120	1,670	1,570	895	940
16	375	590	510	1,880	1,080	1,570	1,480	895	805
17	375	510	550	1,770	985	1,770	1,390	895	760
18	375	475	590	1,480	2,000	2,000	1,390	850	715
19	2,000	440	590	1,770	2,270	1,670	1,390	850	715
20	670	440	510	1,570	6,630	1,670	1,300	805	850
21	510	440	590	1,390	3,700	2,270	1,300	805	760
22	440	440	805	2,930	1,670	3,120	1,210	805	805
23	440	475	760	2,000	2,000	3,310	1,210	760	670
24	440	760	715	1,570	2,750	19,200	1,210	805	630
25	408	590	670	1,480	2,000	6,850	1,210	760	590
26	408	550	630	1,300	1,770	3,700	1,390	760	590
27	408	510	590	1,210	1,670	6,410	1,210	805	630
28	375	510	1,210	1,210	1,570	4,100	1,120	805	715
29	375	850	1,770	1,210	....	3,310	1,120	805	760
30	670	715	1,300	1,390	....	2,580	1,390	715	590
31	760	....	1,030	1,300	....	2,270	....	670	....

Monthly discharge of Hiwassee River at Murphy, N. C., for the year ending Sept. 30, 1917.

[Drainage area, 410 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	2,000	375	495	1.21	1.40
November	850	408	520	1.27	1.42
December	1,770	510	733	1.79	2.06
January	2,930	850	1,440	3.51	4.05
February	6,630	895	1,850	4.51	4.70
March	19,200	1,570	4,080	9.95	11.47
April	3,310	1,120	1,690	4.12	4.60
May	1,390	670	948	2.31	2.66
June	1,880	590	847	2.07	2.31

VALLEY RIVER AT TOMOTLA, N. C.

LOCATION.—At steel highway bridge 600 feet from Tomotla post office, Cherokee County, on Southern Railway, 5 miles northeast of Murphy, N. C.; half a mile upstream from Rodgers Creek, and 1 mile downstream from Colvards Creek.

DRAINAGE AREA.—120 square miles.

RECORDS AVAILABLE.—June 29, 1904, to December 31, 1909; January 21, 1914, to April 30, 1917, when station was discontinued temporarily.

GAGE.—In two sections; lower section, 0.0 to 5.4 feet, is on a sloping timber which is bolted to marble bedrock; upper section, 5.4 to 10 feet, is a vertical staff bolted to timber on old bridge pier. This is the same gage that was in use when station was discontinued in 1909. Gage read by J. T. Hayes.

DISCHARGE MEASUREMENTS.—Made from new single-span steel bridge over site of old footbridge.

CHANNEL AND CONTROL.—Bed of channel composed of gravel, which shifts during big floods. Control, which was at first thought to be a permanent rock ledge just below bridge, now seems to be partly formed by gravel bars in conjunction with the ledge; shifts during great floods.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 15.9 feet at noon, March 4 (discharge, 10,100 second-feet); minimum stage recorded, 1 foot at 6 p. m. October 13, and 7 a. m. and 6 p. m., October 14–16 (discharge, 60 second-feet).

1904–1909 and 1914–1917: Maximum stage recorded, 17.3 feet November 19, 1906 (discharge, about 10,400 second-feet); minimum stage recorded, 0.7 foot October 28 to November 2, 1904 (discharge, 22 second-feet).

ICE.—Stage-discharge relation not affected by ice.

REGULATION.—Very little diurnal fluctuation caused by operation of small mills upstream.

ACCURACY.—Stage-discharge relation probably permanent during year. Rating curve fairly well defined between 60 and 400 second-feet; extension of curve above 400 second-feet not considered accurate. Gage read to tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records fair for stages below 500 second-feet.

Discharge measurements of Valley River at Tomotla, N. C., during the year ending Sept. 30, 1917.

[Made by L. J. Hall.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Oct. 5	1.09	72.6
Dec. 8	1.40	132

Daily discharge, in second-feet, of Valley River at Tomotla, N. C., for the period Oct. 1, 1916, to Apr. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
1	75	95	200	355	2,990	3,690	660
2	75	85	165	312	1,210	2,080	620
3	75	75	145	660	545	5,260	510
4	75	75	135	750	545	8,060	510
5	75	75	188	800	510	4,620	1,270
6	75	75	145	910	475	3,940	1,090
7	75	75	135	600	385	3,270	660
8	75	75	135	385	385	2,600	750
9	75	85	288	385	340	1,926	580
10	75	105	212	312	300	1,250	580
11	75	75	200	300	300	580	510
12	75	95	212	250	275	660	510
13	68	125	188	225	250	580	510
14	60	250	155	660	250	660	445
15	60	200	135	620	385	545	385
16	60	145	135	800	300	545	385
17	75	115	135	620	325	1,210	355
18	85	105	135	750	1,330	855	340
19	165	95	135	660	2,010	660	325
20	105	95	135	580	3,690	580	300
21	75	95	165	510	1,660	1,330	300
22	75	75	275	1,870	855	1,030	300
23	75	385	212	910	750	855	275
24	75	175	200	660	970	3,480	275
25	75	135	188	445	750	1,870	275
26	75	135	175	415	580	2,220	300
27	75	135	188	385	545	3,980	250
28	75	188	1,270	340	2,710	1,800	250
29	75	212	750	580	....	1,270	300
30	165	200	445	510	....	910	250
31	105	....	325	445	....	750	....

NOTE.—No gage-height record from afternoon of Mar. 5 to Mar. 10; discharge estimated.

Monthly discharge of Valley River at Tomotla, N. C., for the period Oct. 1, 1916, to Apr. 1, 1917.

[Drainage area, 120 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	165	60	81.4	0.678	0.78
November	385	75	128	1.07	1.19
December	1,270	135	242	2.02	2.33
January	1,870	225	583	4.86	5.60
February	3,690	250	915	7.62	7.94
March	8,060	545	2,030	16.92	19.48
April	1,270	250	469	3.91	4.36

NOTTELY RIVER NEAR RANGER, N. C.

LOCATION.—About half a mile downstream from Ranger, Cherokee County, which is on Louisville & Nashville Railroad, 7½ miles from Murphy, N. C., and 8 miles upstream from Hiwassee River, to which Nottely River is tributary.

DRAINAGE AREA.—272 square miles.

RECORDS AVAILABLE.—February 16, 1901, to December 31, 1905; January 22, 1914, to April 30, 1917, when station was discontinued temporarily.

GAGE.—Rod gage fastened to a large birch tree on left bank 75 feet upstream from highway bridge; zero same as for original gage which was destroyed by fire in 1913, when a new steel bridge replaced old wooden one. Gage read by A. D. Kilpatrick.

DISCHARGE MEASUREMENTS.—Made from downstream side of steel highway bridge on road from Ranger to Murphy, N. C. Measuring section is poor and uneven and current somewhat erratic, necessitating very careful measurements.

CHANNEL AND CONTROL.—Bed composed of boulders, gravel, and sand; permanent. Right bank high; left bank subject to overflow beyond bridge end at stages above 18 feet. Control is formed by a low shoal about 300 feet downstream from gage: permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 17.4 feet (estimated by observer) at 7 a. m. March 1 (discharge, about 5,780 second-feet); minimum stage recorded, 3.0 feet October 4–18, 23–31, and November 19–22 (discharge, 265 second-feet).

1901–1905 and 1914–1917: Maximum stage recorded, 19.4 feet at 10 a. m. July 10, 1916 (discharge, 6,580 second-feet); minimum stage recorded, 2.1 feet July 2 and 3, August 9, September 9–11, 14–16, 29 and 30, and October 1–4, 1914 (discharge, 89 second-feet).

ICE.—Stage-discharge relation not affected by ice.

REGULATION.—The operation of small mills upstream may cause slight diurnal fluctuations, but not enough to affect accuracy of determinations.

ACCURACY.—Stage-discharge relation permanent; not affected by ice. Rating curve well defined below but extended above 800 second-feet. Gage read to tenths twice daily; gage not extended for use above stage 10 feet; determinations of flood stages subject to error, as they are obtained by measuring from reference point. Daily discharge ascertained by applying mean daily gage height to rating table. Records for stages below 800 second-feet, fair; for those above, poor.

Discharge measurements of Nottely River near Ranger, N. C., during the year ending Sept. 30, 1917.

[Made by L. J. Hall.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Oct. 6	3.01	263
Dec. 11	3.69	414
Feb. 13	4.00	522

Daily discharge, in second-feet, of Nottely River near Ranger, N. C., for the period Oct. 1, 1916, to Apr. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
1	359	524	653	555	1,620	5,780	1,230
2	310	790	524	587	1,380	1,620	1,230
3	287	653	465	1,230	862	2,420	1,190
4	265	653	359	1,160	790	4,980	1,120
5	265	587	359	862	755	4,580	2,020
6	265	524	359	790	721	2,020	1,740
7	265	465	359	721	687	1,620	1,420
8	265	359	334	653	653	1,580	1,380
9	265	310	524	653	620	1,340	1,310
10	265	310	494	620	587	1,160	1,270
11	265	310	465	587	555	1,120	1,230
12	265	310	410	555	555	1,080	1,160
13	265	359	359	524	524	1,160	1,040
14	265	524	359	1,160	524	1,160	1,040
15	265	465	359	1,010	521	1,190	1,010
16	265	359	334	934	524	521	1,010
17	265	310	334	862	524	1,160	971
18	265	310	334	790	1,510	1,230	934
19	1,190	265	465	653	1,620	1,120	898
20	524	265	410	524	1,580	934	862
21	410	265	410	465	2,120	1,940	826
22	310	265	384	1,380	1,230	1,580	826
23	265	862	384	1,160	862	1,980	790
24	265	653	359	1,080	1,620	4,180	790
25	265	524	334	1,010	1,190	2,620	755
26	265	410	334	934	1,080	1,980	971
27	265	359	334	862	1,010	3,380	790
28	265	359	1,620	790	934	2,300	755
29	265	862	826	653	....	1,620	755
30	265	790	755	587	....	1,460	1,190
31	265	....	620	524	....	1,310	....

NOTE.—Gage heights, Feb. 20, Mar. 1, 4, 5, 24, and 27, estimated by observer, discharge may be considerably in error.

Monthly discharge of Nottely River near Ranger, N. C., for the period Oct. 1, 1916, to Apr. 30, 1917.

[Drainage area, 272 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,190	265	315	1.16	1.34
November	862	265	467	1.72	1.92
December	1,620	334	472	1.74	2.01
January	1,380	465	802	2.95	3.40
February	4,580	521	1,090	4.01	4.18
March	5,780	521	2,010	7.39	8.52
April	2,020	755	1,080	3.97	4.43

TOCCOA RIVER NEAR DIAL, GA.

Location.—About 2,600 feet above Shallow Ford, 1 mile above Stanley Creek, 2½ miles below Big Creek, 3½ miles below Noontootley Creek, about 4 miles northwest of Dial, Fannin County, and about 12 miles by river above gaging station at Morganton.

Drainage area.—175 square miles (measured on topographic maps).

Records available.—January 1, 1913, to September 30, 1917. Records were obtained at Butts Bridge about 2 miles above Dial May 17, 1907, to June 30, 1908.

Gage.—Bristol water-stage recorder. Sea-level elevation of zero of auxiliary staff gage, 1,781.13 feet.

Discharge measurements.—Made from cable about 1,000 feet upstream from gage.

Channel and control.—Bed of stream consists of gravel and boulders; fairly smooth. Left bank is overflowed at a stage of about 12 feet. Control is formed by the head of rapids just below gage; probably permanent.

Extremes of discharge.—Maximum mean daily stage during year, 6.47 feet March 4 (discharge, 4,700 second-feet); minimum stage, daily mean, 1 foot September 19 and 20 (discharge, 195 second-feet).

1913–1917: Maximum stage recorded, 10 feet at 6 p. m. July 9, 1916 (discharge 9,200 second-feet); minimum stage, 0.55 foot October 13, 29, and 30, 1914 (discharge, 109 second-feet).

Regulation.—There are slight diurnal fluctuations due to operation of small mills upstream.

Accuracy.—Stage-discharge relation practically permanent. Rating curve well defined below 4,000 second-feet; extended above 4,000 second-feet. Stage-discharge relation never affected by ice. Daily discharge ascertained by applying to the rating table mean daily gage height determined by inspecting gage-height graph. Records excellent.

Discharge measurements of Toccoa River near Dial, Ga., during the year ending Sept. 30, 1917.

[Made by L. J. Hall.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Oct. 2	1.24	278	Dec. 27	1.40	312
Nov. 1	1.35	317	Feb. 10	1.94	583
Dec. 6	1.27	282			

Daily discharge, in second-feet, of Toccoa River near Dial, Ga., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	295	312	312	522	1,580	1,100	1,420	785	570	350	312	785
2	295	278	295	478	1,060	1,130	1,500	728	522	330	278	410
3	278	260	295	570	875	1,980	1,380	700	500	330	312	370
4	260	260	278	570	815	4,700	1,460	1,160	478	330	295	278
5	260	260	312	755	755	3,880	2,450	845	455	330	278	278
6	260	242	278	700	728	2,020	1,840	755	478	370	278	260
7	260	242	278	620	672	1,580	1,500	755	455	330	330	242
8	260	242	278	570	700	1,580	1,540	728	755	330	545	225
9	260	242	455	522	672	1,380	1,500	700	968	312	455	242
10	260	242	370	500	595	1,270	1,380	672	700	312	350	242
11	260	225	350	478	595	1,200	1,300	672	570	295	295	225
12	242	260	350	432	570	1,160	1,270	645	500	295	278	225
13	242	278	312	455	570	1,130	1,300	620	478	295	278	210
14	225	330	295	815	570	1,100	1,100	620	645	295	260	210
15	225	295	312	755	700	1,030	1,060	595	522	312	350	210
16	225	260	278	1,000	595	1,000	1,030	595	478	330	370	278
17	225	242	278	815	570	1,420	1,000	570	455	432	370	210
18	295	225	370	785	845	1,160	968	570	432	432	278	210
19	432	225	330	700	1,750	1,030	935	545	432	370	260	195
20	330	225	312	645	2,200	968	935	545	455	370	260	195
21	295	225	350	672	1,380	1,580	905	522	478	522	242	210
22	260	225	478	1,030	1,100	1,300	875	570	455	500	242	410
23	242	500	390	845	1,100	1,500	845	545	370	390	260	295
24	242	432	350	755	1,240	4,460	845	522	370	330	242	225
25	242	312	350	700	1,100	2,400	845	500	350	312	225	210
26	225	295	330	645	1,000	2,110	905	785	370	410	210	210
27	225	278	370	595	905	2,900	815	522	390	350	210	545
28	225	312	1,380	595	905	2,060	785	595	410	312	210	1,200
29	242	410	875	875	....	1,840	785	522	390	330	210	478
30	700	370	570	700	....	1,620	755	500	350	295	225	370
31	390	....	522	645	....	1,500	....	620	....	312	455	....

Monthly discharge of Toccoa River near Dial, Ga., for the year ending Sept. 30, 1917.

[Drainage area, 175 square miles.]

Month.	Discharge in second-feet. Maximum.	Minimum.	Mean.	Per square mile.	Run-off (depth in inches on drainage area).
October	700	225	280	1.60	1.84
November	500	225	283	1.62	1.81
December	1,380	278	397	2.27	2.62
January	1,030	432	669	3.82	4.40
February	2,200	570	934	5.34	5.56
March	1,700	968	1,780	10.20	11.76
April	2,450	755	1,170	6.69	7.46
May	1,160	500	645	3.69	4.25
June	968	350	493	2.82	3.15
July	522	295	349	1.99	2.29
August	545	210	296	1.69	1.95
September	1,200	195	322	1.84	2.05
The year	4,700	195	633	3.62	49.14

TOCCOA RIVER NEAR MORGANTON, GA.

Location.—At highway bridge on road from Blueridge, Ga., to Morganton, half a mile downstream from mouth of Star Creek, 2 miles west of Morganton post office, Fannin County, 4 miles east of Blueridge, 12 miles downstream from Dial gaging station, 14 miles upstream from Georgia-Tennessee State line at Copperhill, Tenn., and 28 miles upstream from gaging station on Ocoee River at Emf, Tenn. At State line name of river is changed from Toccoa to Ocoee.

Drainage area.—231 square miles (measured on topographic maps).

Records available.—November 25, 1898, to March 31, 1903, and April 1, 1913, to September 30, 1917. Records 1898 to 1903 published in Water-Supply Paper 197, under "Toccoa River near Blueridge, Ga.

Gage.—Bristol water-stage recorder on right bank 200 feet downstream from bridge and 150 feet downstream from the old vertical staff which was used from 1898 to 1903. Zeros of both gages, 1,544.5 feet above sea level, but on account of the slope in water surface the readings of the two gages do not agree for all stages. The water-stage recorder was installed in 1914 (exact date not recorded). A rod gage has been placed at site of automatic gage. Observer visits gage every day and checks record sheet with rod reading.

Discharge measurements.—Made from cable about 1,800 feet downstream from gage.

Channel and control.—Bed composed of gravel and bowlders. Banks high; left subject to overflow at about gage height 15 feet; right bank not subject to overflow. Low-water control is a low shoal or riffle just below gage; high-water control is combination of shoals and banks. Control subject to small shifts at low stages.

Extremes of discharge.—Maximum mean daily stage during year, 10.2 feet March 4 (discharge, 9,410 second-feet); minimum stage, mean from water-stage recorder, 2.50 feet October 15 (discharge, 285 second-feet).

1913–1917: Maximum stage recorded, 13.0 feet at 9 p. m. July 9, 1916 (discharge, 13,900 second-feet); minimum stage, 1.8 feet September 10, 14–17, 29, 30, and October 1, 1914 (discharge, 129 second-feet).

Regulation.—Slight diurnal fluctuations probably caused by operation of small mills upstream.

Accuracy.—Stage-discharge relation for stages below 870 second-feet changed during highwater March 4, 1917. Rating curve used to March 4 well defined below 3,500 second-feet and an extension above that point; curve used subsequent to March 4 is well defined below 3,500 second-feet and coincides with previous curve above 870 second-feet; change below 870 second-feet due to slight shift in low-water control. Stage-discharge relation not affected by ice. Daily discharge ascertained by applying to the rating table mean daily gage height obtained by inspecting gage-height graph. Records good.

Discharge measurements of Toccoa River near Morganton, Ga., during the year ending Sept. 30, 1917.

[Made by L. J. Hall.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Nov. 3	2.65	339	Dec. 28	4.70	1,720
Dec. 4	2.68	347	Feb. 6	3.44	766

Daily discharge, in second-feet, of Toccoa River near Morganton, Ga., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	338	395	395	575	1,980	1,500	1,700	982	729	429	456	1,220
2	338	355	375	545	1,260	1,380	1,660	834	663	404	404	632
3	320	320	355	605	982	2,390	1,580	834	632	404	483	483
4	320	320	355	665	945	9,410	1,580	1,340	632	404	378	404
5	320	320	375	870	835	2,950	1,740	982	600	404	331	354
6	320	320	355	870	835	2,220	2,140	870	600	456	331	331
7	320	302	320	698	765	1,940	1,820	870	632	404	378	331
8	320	302	355	635	800	1,940	1,900	870	908	404	663	354
9	338	302	575	575	765	1,700	1,780	798	1,340	378	632	331
10	320	338	440	545	665	1,580	1,660	798	1,020	354	483	331
11	320	302	395	518	665	1,500	1,580	764	729	354	483	310
12	302	320	395	465	665	1,500	1,540	764	663	331	378	290
13	302	375	355	490	635	1,420	1,540	729	663	331	354	290
14	302	440	338	1,100	605	1,380	1,300	729	945	354	331	290
15	285	375	355	870	835	1,300	1,260	696	663	404	331	331
16	320	320	320	1,260	698	1,220	1,220	696	570	404	404	456
17	302	320	338	1,020	665	1,780	1,180	663	600	456	456	354
18	320	302	395	908	1,020	1,460	1,140	663	600	540	354	290
19	800	302	395	870	1,820	1,340	1,140	663	600	512	331	290
20	418	302	355	730	2,740	1,260	1,100	663	600	483	331	290
21	338	302	395	800	1,540	1,980	1,100	663	600	982	310	290
22	320	302	490	605	1,420	1,660	1,060	663	600	729	310	456
23	320	665	440	782	1,420	1,860	1,020	696	570	600	331	429
24	302	575	418	870	1,660	6,530	982	632	570	483	310	310
25	302	395	395	800	1,380	2,740	982	632	570	456	290	290
26	302	355	375	730	1,180	2,460	1,060	870	570	540	290	290
27	302	338	375	665	1,860	3,200	945	663	570	512	290	456
28	302	395	1,580	665	1,820	2,380	908	729	600	483	290	1,500
29	302	545	1,020	1,020	....	2,220	945	632	600	456	290	570
30	945	465	698	870	....	2,740	945	632	456	429	331	429
31	518	....	605	730	....	1,740	....	798	....	404	834	....

Monthly discharge of Toccoa River near Morganton, Ga., for the year ending Sept. 30, 1917.

[Drainage area, 231 square miles.]

Month	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	945	285	361	1.56	1.80
November	665	302	366	1.58	1.76
December	1,580	320	462	2.00	2.31
January	1,260	465	753	3.26	3.76
February	2,740	605	1,160	5.02	5.23
March	9,410	1,220	2,280	9.87	11.38
April	2,140	908	1,350	5.84	6.52
May	1,340	632	768	3.32	3.83
June	1,340	456	670	2.90	3.24
July	982	331	461	2.00	2.31
August	834	290	393	1.70	1.96
September	1,500	290	433	1.87	2.09
The year	9,410	285	786	3.40	46.19

OCOEE RIVER AT McHARGE, TENN.

Location.—At Rogers Ferry county highway bridge, Polk County, about half a mile downstream from McHarge railroad siding, half a mile downstream from mouth of Potato Creek, and 2½ miles downstream from Copperhill, Tenn.

Drainage area.—451 square miles (measured on topographic maps).

Records available.—May 1, 1917, to September 30, 1917.

Gage.—Vertical staff bolted to left downstream side of concrete bridge pier on left bank; read by B. V. Karaivanoff.

CHANNEL AND CONTROL.—Left bank subject to overflow at extreme stages, but water will always pass under bridge. Channel straight for about 300 feet above and 700 feet below gage. Control consists of solid rock riffle about 300 feet below gage; practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period of records, 6.0 feet, at 4 p. m., August 30 (discharge not determined); minimum stage recorded, 0.7 foot at 4 p. m., September 14 and 7 a. m., Septenber 15 (discharge, 445 second-feet).

ICE.—Stage-discharge relation not affected by ice.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent; not affected by ice. Rating curve well defined between 400 and 2,000 second-feet; extended above 2,500 second-feet. Gage read to half-tenths twice daily; oftener during high water. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Ocoee River at McHarge, Tenn., during the year ending Sept. 30, 1917.

[Made by L. J. Hall.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Apr. 27	2.35	1,760	Aug. 28	.73	461
June 2	1.69	1,140	Sept. 19	.78	481
July 18	1.75	1,220			

Daily discharge, in second-feet, of Ocoee River at McHarge, Tenn., for the year ending Sept. 30, 1917.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1	1,710	1,340	770	770	2,250	16	1,250	1,070	700	700	700
2	1,610	1,250	700	1,430	1,160	17	1,200	915	770	700	665
3	1,520	1,250	700	700	1,070	18	1,160	915	1,030	598	617
4	2,370	1,160	735	770	840	19	1,160	915	878	565	505
5	1,710	990	630	630	770	20	1,160	1,160	805	665	505
6	1,610	952	770	630	700	21	1,070	990	1,250	665	553
7	1,610	1,250	770	735	630	22	1,810	1,030	1,340	617	617
8	1,610	1,810	700	3,020	617	23	1,430	878	840	598	805
9	1,520	2,020	700	1,200	617	24	1,250	840	840	630	617
10	1,430	2,020	630	1,200	598	25	1,160	805	990	565	553
11	1,430	1,430	598	805	565	26	1.910	770	915	535	517
12	1,380	1,160	598	840	517	27	1,300	770	990	535	3,020
13	1,340	1,070	598	665	493	28	1,160	915	700	505	3,830
14	1,300	1,610	565	630	457	29	1,160	805	3,150	493	1,160
15	1,250	1,250	700	700	457	30	1,070	770	770	5,290	878
						31	1,250	....	770	3,280	....

Monthly discharge of Ocoee River at McHarge, Tenn., for the year ending Sept. 30, 1917.

[Drainage area, 451 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
May	2,370	1,070	1,420	3.15	3.63
June	2,020	770	1,140	2.53	2.82
July	3,150	565	868	1.92	2.21
August	5,290	493	1,020	2.26	2.61
September	3,830	457	909	2.02	2.25

OCOEE RIVER AT EMF, TENN.

Location.—About 600 feet below Tennessee Power Co.'s plant No. 2, known as the "Caney Creek plant," half a mile upstream from Emf post office, Polk County, 1½ miles downstream from mouth of Goforth Creek, and 8 miles upstream from Parksville, Tenn.

Drainage area.—530 square miles (determined by Tennessee Power Co.).

Records available.—January 1, 1913, to September 30, 1917.

Gage.—Bristol water-stage recorder on left bank; checked daily with a staff gage which is bolted to rock near the Bristol. Readings from gage give elevation above sea-level.

Discharge measurements.—Made from cable at first good section one-half mile downstream from gage, near Emf post office.

Channel and control.—Bed of stream for several hundred feet below gage is composed of boulders, gravel and solid rock. Banks high, subject to small overflow. Control is formed by a shoal and island 700 feet downstream from gage; probably permanent.

Extremes of discharge.—Maximum mean daily stage during year, 12.7 feet March 4 (discharge, 19,200 second-feet); minimum stage, mean for day, from water-stage recorder, 3.15 feet on October 8 (discharge, 440 second-feet).

1913, 1917: Maximum stage recorded, 13.7 feet at 12.30 a. m. July 10, 1916 (discharge, 21,400 second-feet); minimum stage, 2.77 feet September 15–17, 1914 (discharge, 285 second-feet).

Regulation.—The operation of plant No. 2 causes considerable fluctuation at times, but, as a rule, this plant runs on a steady load, the quantity of water used depending largely on stage of river. Storage at diversion dam very small. When plant is shut down water overflows dam in a short time, so that periods of fluctuation will be short.

Accuracy.—Stage-discharge relation practically permanent; not affected by ice. Rating curve well defined between 400 and 8,000 second-feet; above 8,000 second-feet curve is extended as a tangent. Daily discharge ascertained by applying to rating table mean daily gage height determined by inspecting gage-height graph. Records excellent.

Discharge measurements of Ocoee River at Emf, Tenn., during the year ending Sept. 30, 1917.

[Made by L. J. Hall.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Oct. 12	3.26	594	Aug. 29	3.26	513
Feb. 20	7.22	7,110	Sept. 16	3.36	592
Aug. 23	3.39	676			

Note.—Discharge measurements, Aug. 29, and Sept. 16, were made from the suspension bridge 1,200 feet downstream from gage; measuring section good. All measurements at this station prior to Aug. 29, 1917, were made from the cable, 2,000 feet downstream from gage; measuring section rough. Discharge measurements made at the new section indicate that measurements at the old section gave too high results for stages below 2,000 second-feet.

Daily discharge, in second-feet, of Ocoee River at Emf, Tenn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	501	673	776	1,130	3,900	5,280	3,700	1,890	1,240	802	758	2,550
2	466	568	673	1,170	2,920	4,740	3,600	1,720	1,220	784	706	1,690
3	466	530	623	1,360	1,960	4,320	3,400	1,690	1,180	802	681	875
4	459	523	592	1,570	1,700	19,200	3,200	2,370	1,180	811	741	848
5	459	516	623	1,570	1,960	12,600	6,420	2,200	1,100	767	656	750
6	447	479	648	1,890	1,640	5,060	5,580	1,720	1,030	793	623	698
7	453	472	576	1,460	1,690	8,830	4,110	1,640	1,320	838	681	698
8	440	466	776	1,320	1,420	5,060	4,110	1,630	1,890	776	1,690	706
9	447	472	1,130	1,130	1,430	5,370	4,110	1,590	1,760	706	1,740	903
10	487	545	961	1,040	1,280	3,500	3,600	1,570	1,630	681	1,640	681
11	538	494	820	980	1,240	3,110	3,200	1,510	1,460	640	903	607
12	487	501	741	922	1,160	3,020	3,020	1,490	1,290	640	723	592
13	487	508	698	913	1,110	3,200	3,020	1,420	1,110	631	681	568
14	479	811	615	2,280	1,110	3,020	2,820	1,400	1,180	640	689	568
15	466	784	640	1,690	1,340	2,820	2,730	1,380	1,460	673	715	508
16	479	553	615	2,730	1,360	2,550	2,550	1,330	1,110	723	875	706
17	472	561	592	2,370	1,280	4,220	2,370	1,300	1,130	793	961	951
18	553	523	673	1,820	2,640	3,600	2,280	1,290	1,080	1,960	732	592
19	1,500	494	866	1,820	4,220	2,820	2,200	1,820	980	1,080	723	615
20	922	472	741	1,570	8,170	2,550	2,120	1,240	1,180	884	848	508
21	656	472	706	1,480	5,580	4,740	2,120	1,210	1,130	1,320	829	501
22	576	472	970	3,300	3,600	4,320	2,040	1,490	1,100	2,820	640	584
23	530	866	866	2,460	3,200	5,790	1,960	1,470	980	1,130	615	838
24	516	1,240	866	1,890	3,500	5,580	1,820	1,220	884	884	607	623
25	516	758	793	1,630	2,550	8,390	1,690	1,180	838	820	553	506
26	501	640	758	1,470	2,200	6,850	2,040	1,180	793	932	538	523
27	466	584	741	1,360	2,120	6,850	1,960	1,310	942	838	523	793
28	466	648	3,600	1,300	1,890	6,630	1,890	1,320	932	793	530	2,920
29	479	848	2,730	2,200	....	5,160	2,200	1,210	884	706	600	1,510
30	1,070	875	1,430	1,960	....	4,420	2,120	1,100	838	750	1,200	932
31	900	....	1,160	1,690	....	3,900	....	1,120	....	706	1,890	....

Monthly discharge of Ocoee River at Emf, Tenn., for the year ending Sept. 30, 1917.

[Drainage area, 530 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,590	440	576	1.09	1.26
November	1,240	466	612	1.15	1.28
December	3,600	576	935	1.76	2.03
January	3,300	913	1,660	3.13	3.61
February	8,170	1,110	2,430	4.58	4.77
March	19,200	2,550	5,400	10.2	11.76
April	6,420	1,690	2,930	5.53	6.17
May	2,370	1,100	1,480	2.79	3.22
June	1,890	793	1,160	2.19	2.44
July	2,820	631	907	1.71	1.97
August	1,890	523	848	1.60	1.84
September	2,920	501	878	1.66	1.85
The year	19,200	440	1,650	3.11	42.20

BIG BEAR RIVER NEAR RED BAY, ALA.

Location.—At Norman Bridge 2½ miles east of Red Bay, Franklin County, 3 miles east of Mississippi State line, 4 miles downstream from mouth of Blue Creek, and 35 miles upstream from junction with Tennessee River.

Drainage area.—254 square miles (measured on map compiled by United States Geological Survey, 1912; scale, 1:500,000).

Records available.—August 24, 1913, to September 30, 1917.

GAGE.—Vertical staff attached to a sweet-gum tree on left bank, 25 feet upstream from bridge; read by Ed Bullen. On February 27, 1917, gage was found to have settled 0.27 foot. Gage was correct on January 2, 1915, when it was checked with bench mark. Flood of July, 1916, is assumed to have undermined tree to which gage is attached, causing it to settle. On April 9 and 11, 1918, settlement of gage was found to have increased to 0.53 foot at gage height 1.5 feet, the error increasing to 0.66 foot at 8.0-foot mark on gage, owing to inclination of gage. A gradual settlement of gage from July, 1916, to April 9, 1918, has been assumed and corrections applied to observer's gage readings before determining discharge.

CHANNEL AND CONTROL.—Bed of river consists of gravel; probably shifting. During extreme low water current is sluggish and irregular. Left bank subject to overflow at stages above 12 feet. Control is a gravel bar 100 feet downstream; practically permanent except for a shift which probably occurred in April, 1917.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.9 feet April 6 (discharge, 4,760 second-feet): minimum discharge, 20 second-feet September 13, 15, and 26.

1913–1917: Maximum stage recorded, 14.2 feet at 7 p. m. July 9, 1916 (discharge, 5,720 second-feet); minimum discharge, 15 second-feet July 7, 8, and September 18, 1914.

ICE.—Stage-discharge relation not affected by ice.

ACCURACY.—Stage-discharge relation practically permanent from 1913 until the high water in April, 1916, when the shift in control indicated by current-meter measurements made in April, 1918, probably occurred. Rating curve used August 24, 1913, to April 5, 1917, well defined between 400 and 3,000 second-feet and fairly well defined outside these limits. Curve used April 6 to September 30, 1917, well defined between 80 and 4,000 second-feet; poorly defined below 80 second-feet. Gage read to tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good from August, 1913, to probably June, 1916. Records from July to December, 1916, are only fair, and at low stages may be considerably in error, owing to large percentage errors introduced by small errors in gage-height corrections noted in paragraph concerning gage. Records from January to March, 1917, probably good; those from April to September, 1917, only fair, and discharge determinations for low stages should be used with caution.

The following discharge measurement was made by L. J. Hall:

February 27, 1917: Gage height, 3.23 feet (referred to original datum of gage); discharge, 572 second-feet.

Daily discharge, in second-feet, of Big Bear River near Red Bay, Ala., for the years ending Sept. 30, 1913–1917.

Day.	Aug.	Sept.	Day.	Aug.	Sept.	Day.	Aug.	Sept.
1913.			1913.			1913.		
1		27	11		27	21		110
2		27	12		27	22		74
3		27	13		27	23		59
4		27	14		27	24	39	52
5		27	15		27	25	46	52
6		27	16		27	26	39	39
7		27	17		27	27	39	39
8		27	18		74	28	39	39
9		27	19		110	29	33	148
10		27	20		119	30	33	461
						31	27	

Daily discharge, in second-feet, of Big Bear River near Red Bay, Ala., for the years ending Sept. 30, 1913-1917—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1913-14.												
1	414	52	82	158	158	368	4,520	280	66	27	66	119
2	158	52	82	158	218	346	3,580	238	66	27	52	82
3	100	52	66	138	178	302	2,360	238	66	27	82	82
4	82	52	66	138	138	280	1,450	218	52	27	66	259
5	66	39	66	138	178	280	974	218	52	27	280	178
6	52	39	66	119	585	302	735	259	391	27	178	119
7	46	39	82	119	2,160	302	535	280	660	27	119	82
8	39	52	82	119	1,450	280	710	510	760	15	100	52
9	39	52	82	100	735	280	660	585	259	15	82	39
10	39	52	82	100	510	259	510	437	178	82	52	39
11	52	52	66	100	836	259	437	280	138	100	52	27
12	52	52	66	100	918	368	535	238	218	158	52	27
13	52	52	66	82	660	1,090	1,060	198	238	82	100	27
14	39	52	66	82	685	710	735	178	119	52	368	39
15	39	52	82	82	735	560	1,030	158	119	39	324	27
16	39	52	100	82	560	461	760	158	280	862	138	27
17	39	52	100	82	510	391	610	138	391	1,360	82	27
18	39	52	100	82	437	324	510	158	238	461	66	15
19	39	66	82	82	391	302	391	158	138	238	52	27
20	52	66	82	66	437	280	368	138	119	100	52	52
21	52	52	82	66	510	280	324	119	100	66	39	82
22	52	52	66	66	391	238	280	100	82	66	52	66
23	39	52	66	66	324	218	280	100	82	52	66	52
24	82	52	82	66	414	198	259	100	66	52	66	39
25	100	52	119	82	461	178	238	100	52	52	52	437
26	82	52	218	119	414	178	238	82	52	39	39	178
27	66	52	238	119	368	218	218	82	39	39	66	119
28	66	52	198	100	391	238	198	82	39	39	100	82
29	66	52	178	82	......	238	238	82	39	39	138	66
30	52	66	178	82	......	1,120	302	82	39	39	391	52
31	52	......	178	100	......	4,420	......	66	......	119	158	......
1914-15.												
1	52	52	391	1,240	4,120	368	368	119	100	218	27	198
2	52	39	218	785	5,020	368	324	138	178	158	27	158
3	66	39	158	635	3,050	346	280	138	138	158	27	119
4	66	39	198	510	1,660	324	280	119	119	259	27	100
5	52	39	280	437	1,330	585	259	100	100	302	27	100
6	52	27	238	437	1,570	1,450	259	100	100	461	27	82
7	52	27	178	414	1,210	1,030	238	198	82	280	27	82
8	39	39	158	368	974	785	238	585	82	198	27	66
9	39	52	158	346	810	635	218	368	66	510	52	82
10	82	82	138	302	685	535	218	259	66	760	82	368
11	52	82	119	324	585	485	238	198	52	302	238	280
12	66	82	119	1,060	510	437	585	368	52	218	510	138
13	119	66	138	1,150	461	391	437	760	52	158	391	100
14	302	66	218	890	585	368	324	535	82	119	280	82
15	485	66	238	710	760	346	280	437	66	100	158	82
16	391	52	218	585	760	368	280	324	66	82	100	66
17	198	52	198	660	635	391	259	259	52	82	82	66
18	158	52	178	1,690	510	368	238	238	52	82	66	52
19	100	52	178	2,920	461	324	218	218	39	66	82	52
20	82	52	198	1,880	437	346	198	178	39	82	810	52
21	82	39	218	1,120	414	324	178	158	39	82	346	82
22	66	39	218	1,030	414	302	178	138	39	66	198	66
23	66	39	238	1,240	437	280	218	138	52	82	119	52
24	66	52	280	2,850	461	280	198	119	52	82	218	52
25	52	52	1,810	2,040	391	259	178	100	52	52	100	39
26	52	52	4,120	1,270	368	238	158	100	52	52	280	39
27	52	52	2,590	946	346	238	138	82	39	52	635	39
28	39	66	1,120	760	346	259	138	82	52	39	1,570	39
29	39	119	1,480	635	......	259	138	82	52	39	461	39
30	39	302	3,580	585	......	280	119	119	560	39	280	82
31	39	......	2,130	635	......	302	......	119	......	27	238	......

Daily discharge, in second-feet, of Big Bear River near Red Bay, Ala., for the years ending Sept. 30, 1913–1917—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915-16.												
1	2,390	138	461	1,880	1,240	918	461	238	368	100	259	100
2	2,790	138	391	1,780	1,120	974	437	238	218	510	238	82
3	685	119	346	2,000	890	1,150	890	259	178	218	238	82
4	437	119	302	1,660	735	862	1,630	391	158	346	346	82
5	1,030	100	280	1,210	660	685	1,060	461	158	635	760	82
6	1,120	100	280	946	610	635	810	346	138	280	368	82
7	635	100	259	785	635	635	685	280	461	1,330	280	66
8	414	100	259	685	585	610	1,090	259	346	5,420	324	66
9	302	82	259	560	535	510	1,300	238	259	5,600	974	66
10	259	82	238	510	1,330	461	918	218	198	5,320	560	82
11	238	82	238	485	1,060	414	760	198	158	3,580	437	119
12	218	100	218	461	862	368	635	178	158	4,420	346	100
13	198	198	259	918	760	346	535	178	138	3,420	280	82
14	198	198	238	1,330	660	346	461	158	138	2,890	368	66
15	218	735	218	974	585	368	414	158	368	2,790	302	66
16	218	1,630	218	735	535	346	368	178	259	2,660	259	66
17	198	710	259	660	510	324	346	461	368	1,690	218	66
18	178	485	1,210	610	485	302	324	391	238	1,880	178	66
19	158	1,360	2,230	535	461	302	302	280	178	1,510	158	66
20	1,330	1,540	1,210	510	414	280	302	238	158	1,910	158	66
21	685	810	785	510	391	280	485	218	138	1,060	198	66
22	414	535	560	1,360	368	259	710	238	119	974	178	66
23	302	461	510	4,720	368	259	437	610	119	785	158	66
24	238	391	461	2,960	437	238	368	437	346	610	158	119
25	218	346	760	1,570	414	238	324	368	535	485	178	100
26	198	368	1,750	1,120	368	918	302	280	198	414	158	82
27	178	1,450	1,120	946	346	1,840	280	238	158	368	138	82
28	178	1,180	862	1,120	324	1,060	280	218	138	324	138	66
29	158	810	2,720	1,030	324	760	259	198	119	302	119	66
30	158	535	4,720	862	......	610	259	198	100	346	100	66
31	158	......	2,590	735	......	510	......	391	......	302	100	......
1916-17.												
1	82	52	302	560	2,330	1,150	660	185	1,670	130	148	78
2	82	52	218	535	3,580	2,960	710	185	646	148	223	95
3	66	66	158	1,120	1,630	2,920	862	166	326	112	933	78
4	66	66	138	1,150	974	4,320	760	185	243	78	646	62
5	66	66	119	1,000	810	4,820	4,520	369	204	78	305	62
6	66	66	119	1,420	635	2,960	4,760	284	185	166	223	78
7	66	52	119	918	535	1,720	2,570	204	223	130	166	62
8	66	52	158	685	535	1,210	1,730	185	722	204	204	62
9	66	52	302	560	485	974	1,580	166	2,500	223	391	46
10	66	82	259	461	437	810	1,070	148	3,290	148	347	46
11	82	82	238	414	368	946	826	130	1,860	112	223	32
12	82	82	198	368	280	1,210	696	130	774	95	166	32
13	82	66	158	324	302	1,060	622	130	481	95	148	20
14	66	66	119	368	324	1,360	574	130	369	78	130	32
15	66	66	100	735	437	1,570	504	112	263	62	112	20
16	52	66	100	660	1,120	1,150	458	112	223	62	95	32
17	52	66	119	535	810	1,060	413	112	204	62	95	112
18	66	66	138	585	974	1,510	369	112	204	78	130	95
19	82	66	158	660	2,200	1,000	326	95	185	95	95	78
20	119	66	198	760	3,670	810	305	95	166	78	78	62
21	138	66	178	810	4,220	890	284	95	166	391	62	46
22	138	100	158	1,540	2,360	2,290	263	148	148	166	243	32
23	119	178	158	2,520	1,450	2,230	243	130	148	1,100	185	32
24	100	158	138	1,450	1,030	2,890	223	130	130	671	391	32
25	100	198	138	1,000	810	4,320	204	148	130	574	166	32
26	82	138	158	785	685	2,390	204	166	130	369	112	20
27	82	100	198	635	635	1,840	185	148	112	204	78	62
28	66	100	3,420	560	610	1,600	185	166	95	166	62	879
29	66	82	3,180	510	......	1,150	166	166	112	148	46	527
30	66	138	1,150	485	......	918	166	130	112	204	62	185
31	66	......	660	535	......	735	......	879	......	166	62	......

Monthly discharge of Big Bear River near Red Bay, Ala., for the years ending Sept. 30, 1913–1917.

[Drainage area, 254 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1913.					
September	461	27	61.2	0.241	0.27
1913–14.					
October	414	39	70.5	.278	.32
November	66	39	52.1	.205	.23
December	238	66	102	.402	.46
January	158	66	99.2	.391	.45
February	2,160	138	563	2.22	2.31
March	4,420	178	493	1.94	2.24
April	4,520	198	835	3.29	3.67
May	585	66	195	.768	.89
June	760	39	171	.673	.75
July	1,360	15	140	.551	.64
August	391	39	114	.449	.52
September	437	15	84.0	.331	.37
The year	4,520	15	240	.945	12.85
1914–15.					
October	485	39	99.9	.393	.45
November	302	27	62.3	.245	.27
December	4,120	119	700	2.76	3.18
January	2,920	302	992	3.91	4.51
February	5,020	346	1,050	4.13	4.30
March	1,450	238	428	1.69	1.95
April	585	119	246	.969	1.08
May	760	82	222	.874	1.01
June	560	39	85.7	.337	.38
July	760	27	168	.661	.76
August	1,570	27	242	.953	1.10
September	368	39	95.1	.374	.42
The year	5,020	27	363	1.43	19.41
1915–16.					
October	2,790	158	519	2.04	2.35
November	1,630	82	500	1.97	2.20
December	4,720	218	846	3.33	3.84
January	4,720	461	1,170	4.61	5.32
February	1,330	324	621	2.44	2.63
March	1,840	238	574	2.26	2.61
April	1,630	259	581	2.29	2.56
May	610	158	282	1.11	1.28
June	535	100	220	.866	.97
July	5,600	100	1,690	6.65	7.67
August	974	100	280	1.10	1.27
September	119	66	77.7	.306	.34
The year	5,600	66	618	2.43	33.04
1916–17.					
October	138	52	79.5	.313	.36
November	198	52	85.2	.335	.37
December	3,420	100	418	1.65	1.90
January	2,520	324	795	3.13	3.61
February	4,220	280	1,220	4.80	5.00
March	4,820	735	1,830	7.20	8.30
April	4,760	166	881	3.47	3.87
May	879	95	179	.705	.81
June	3,290	95	534	2.10	2.34
July	1,100	62	206	.811	.94
August	933	46	204	.803	.93
September	879	20	101	.398	.44
The year	4,820	20	541	2.13	28.87

INDEX.

STREAM-GAGING STATIONS

AND

PUBLICATIONS RELATING TO WATER RESOURCES

PART III.—OHIO RIVER BASIN

STREAM-GAGING STATIONS AND PUBLICATIONS RELATING TO WATER RESOURCES.

INTRODUCTION.

Investigation of water resources by the United States Geological Survey has consisted in large part of measurements of the volume of flow of streams and studies of the conditions affecting that flow, but it has comprised also investigation of such closely allied subjects as irrigation, water storage, water powers, ground waters, and quality of waters. Most of the results of these investigations have been published in the series of water-supply papers, but some have appeared in the monographs, bulletins, professional papers, and annual reports.

The results of stream-flow measurements are now published annually in 12 parts, each part covering an area whose boundaries coincide with natural drainage features as indicated below:

Part I. North Atlantic slope basins.
II. South Atlantic slope and eastern Gulf of Mexico basins.
III. Ohio River basin.
IV. St. Lawrence River basin.
V. Upper Mississippi River and Hudson Bay basins.
VI. Missouri River basin.
VII. Lower Mississippi River basin.
VIII. Western Gulf of Mexico basins.
IX. Colorado River basin.
X. Great Basin.
XI. Pacific slope basins in California.
XII. North Pacific slope basins, in three parts:
A, Pacific slope basins in Washington and upper Columbia River basin.
B. Snake River basin.
C, Lower Columbia River basin and Pacific slope basins in Oregon.

HOW GOVERNMENT REPORTS MAY BE OBTAINED OR CONSULTED.

Water-supply papers and other publications of the United States Geological Survey containing data in regard to the water resources of the United States may be obtained or consulted as indicated below.

1. Copies may be obtained free of charge by applying to the Director of the Geological Survey, Washington, D. C. The edition printed for free distribution is, however, small and is soon exhausted.

2. Copies may be purchased at nominal cost from the Superintendent of Documents, Government Printing Office, Washington, D. C., who will, on application, furnish lists giving prices.

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3. Sets of the reports may be consulted in the libraries of the principal cities in the United States.

4. Complete sets are available for consultation in the local offices of the water-resources branch of the Geological Survey, as follows:

Boston, Mass., 2500 Customhouse.
Albany, N. Y., 704 Journal Building.
Atlanta, Ga., Post Office Building.
Madison, Wis., care of Railroad Commission of Wisconsin.
Austin, Tex., Capitol Building.
Helena, Mont., Montana National Bank Building.
Boise, Idaho, 615 Idaho Building.
Topeka, Kans., 23 Federal Building.
Denver, Colo., 403 New Post Office Building.
Tucson, Ariz., University of Arizona.
Salt Lake City, Utah, 313 Federal Building.
Tacoma, Wash., 406 Federal Building.
Portland, Oreg., 606 Post Office Building.
San Francisco, Calif., 328 Customhouse.
Los Angeles, Calif., 619 Federal Building.
Honolulu, Hawaii, 25 Capitol Building.

A list of the Geological Survey's publications may be obtained by applying to the Director, United States Geological Survey, Washington, D. C.

STREAM-FLOW REPORTS.

Stream-flow records have been obtained at more than 4,240 points in the United States, and the data obtained have been published in the reports tabulated on page 2.

Stream-flow data in reports of the United States Geological Survey.

[A=Annual Report; B=Bulletin; W=Water-Supply Paper.]

Report.	Character of data.	Year.
10th A, pt. 2	Descriptive information only	
11th A, pt. 2	Monthly discharge and descriptive information	1884 to Sept., 1890.
12th A, pt. 2	do	1884 to June 30, 1891.
13th A, pt. 3	Mean discharge in second-feet	1884 to Dec. 31, 1892.
14th A, pt. 2	Monthly discharge (long-time records, 1871 to 1893)	1888 to Dec. 31, 1893.
B 131	Descriptions, measurements, gage heights, and ratings	1893 and 1894.
16th A, pt. 2	Descriptive information only	
B 140	Descriptions, measurements, gage heights, ratings, and monthly discharge (also many data covering earlier years).	1895.
W 11	Gage heights (also gage heights for earlier years)	1896.
18th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge (also similar data for some earlier years).	1895 and 1896.
W 15	Descriptions, measurements, and gage heights, eastern United States, eastern Mississippi River, and Missouri River above junction with Kansas.	1897.
W 16	Descriptions, measurements, and gage heights, western Mississippi River below junction of Missouri and Platte, and western United States.	1897.
19th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge (also some long-time records).	1897.
W 27	Measurements, ratings, and gage heights, eastern United States, eastern Mississippi River, and Missouri River.	1898.
W 28	Measurements, ratings, and gage heights, Arkansas River and western United States.	1898.
20th A, pt. 4	Monthly discharge (also for many earlier years)	1898.
W 35 to 39	Descriptions, measurements, gage heights, and ratings	1899.
21st A, pt. 4	Monthly discharge	1899.
W 47 to 52	Descriptions, measurements, gage heights, and ratings	1900.
22d A, pt. 4	Monthly discharge	1900.
W 65, 66	Descriptions, measurements, gage heights, and ratings	1901.
W 75	Monthly discharge	1901.
W 82 to 85	Complete data	1902.
W 97 to 100	do	1903.
W 124 to 135	do	1904.
W 165 to 178	do	1905.
W 201 to 214	do	1906.
W 241 to 252	do	1907–8.
W 261 to 272	do	1909.
W 281 to 292	do	1910.
W 301 to 312	do	1911.
W 321 to 332	do	1912.
W 351 to 362	do	1913.
W 381 to 394	do	1914.
W 401 to 414	do	1915.
W 431 to 444	do	1916.
W 451 to 464	do	1917.

NOTE.—No stream-flow data are given in the 15th and 17th annual reports.

The records at the most of the stations discussed in these reports extend over a series of years, and miscellaneous measurements at many points other than regular gaging stations have been made each year. An index of the reports containing records obtained prior to 1904 has been published in Water-Supply Paper 119.

The following table gives, by years and drainage basins, the numbers of the papers on surface-water supply published from 1899 to 1917. The data for any particular station will be found in the reports covering the years during which the station was maintained. For example, data from 1902 to 1917 for any station in the area covered by Part III are published in Water-Supply Papers 83, 98, 128, 169, 205, 243, 263, 283, 303, 323, 353, 383, 403, 433, and 453 which contain records for the Ohio River basin for those years.

Numbers of water-supply papers containing results of stream measurements, 1899–1917.

Year.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII North Pacific slope basins.		
	North Atlantic slope basins. (St. John River to York River).	South Atlantic slope and eastern Gulf of Mexico basins. (James River to the Mississippi).	Ohio River. basin.	St. Lawrence River basin.	Hudson Bay and upper Mississippi River. basins.	Missouri River. basin.	Lower Mississippi River basin.	Western Gulf of Mexico basins.	Colorado River basin.	Great Basin.	Pacific slope basins in California.	Pacific slope basins in Washington and upper Columbia River basin.	Snake River basin.	Lower Columbia River basin and Pacific slope basins in Oregon.
1899 a	35	b 35, 36	36	36	36	c 36, 37	37	37	d 37, 38	38, e 39	38, f 39	38	38	38
1900 g	47, h 48	48	48, i 49	49	49	49, j 50	50	50	50	51	51	51	51	51
1901	65, 75	65, 75	65, 75	65, 75	k 65, 66, 75	66, 75	k 65, 66, 75	66, 75	66, 75	66, 75	66, 75	66, 75	66, 75	66, 75
1902	82	b 82, 83	83	l 82, 83	k 83, 85	84	k 83, 84	84	85	85	85	85	85	85
1903	97	b 97, 98	98	97	k 98, 99, m 100	99	k 98, 99	99	100	100	100	100	100	100
1904	n 124, o 125, p 126	p 126, 127	128	129	k 128, 130	130, q 131	k 128, 131	132	133	133, r 134	134	135	135	135
1905	n 165, o 166, p 167	p 167, 168	169	170	171	172	k 179, 173	174	175, s 177	176, r 177	177	178	178	t 177, 178
1906	n 201, o 202, p 203	p 203, 204	205	206	207	208	k 205, 209	210	211	212, r 213	213	214	214	214
1907–8	241	242	243	244	245	246	247	248	249	250, r 251	251	252	252	252
1909	261	262	263	264	265	266	267	268	269	270, r 271	271	272	272	272
1910	281	282	283	284	285	286	287	288	289	290	291	292	292	292
1911	301	302	303	304	305	306	307	308	309	310	311	312	312	312
1912	321	322	323	324	325	326	327	328	329	330	331	332–A	332–B	332–C
1913	351	352	353	354	355	356	357	358	359	360	361	362–A	362–B	362–C
1914	381	382	383	384	385	386	387	388	389	390	391	392	393	394
1915	401	402	403	404	405	406	407	408	409	410	411	412	413	414
1916	431	432	433	434	435	436	437	438	439	440	441	442	443	444
1917	451	452	453	454	455	456	457	458	459	460	461	462	463	464

a Rating tables and index to Water-Supply Papers 35–39 contained in Water Supply Paper 39. Tables of monthly discharge for 1899 in Twenty-first Annual Report, Part IV.
b James River only.
c Gallatin River.
d Green and Gunnison rivers and Grand River above junction with Gunnison.
e Mohave River only.
f Kings and Kerns rivers and south Pacific slope basins.
g Rating tables and index to Water-Supply Papers 47–52 and data on precipitation, wells, and irrigation in California and Utah contained in Water-Supply Paper 52. Tables of monthly discharge for 1900 in Twenty-second Annual Report, Part IV.
h Wissahickon and Schuylkill rivers to James River.
i Scioto River.
j Loup and Platte rivers near Columbus, Nebr., and all tributaries below junction with Platte.
k Tributaries of Mississippi from east.
l Lake Ontario and tributaries to St. Lawrence River proper.
m Hudson Bay only.
n New England Rivers only.
o Hudson River to Delaware River, inclusive.
p Susquehanna River to Yadkin River, inclusive.
q Platte and Kansas Rivers.
r Great Basin in California, except Truckee and Carson river basins.
s Below junction with Gila.
t Rogue, Umpqua, and Siletz rivers only.

In these papers and in the following lists the stations are arranged in downstream order. The main stem of any river is determined by measuring or estimating its drainage area: That is, the headwater stream having the largest drainage area is considered the continuation of the main stream, and local changes in name and lake surface are disregarded. All stations from the source to the mouth of the main stem of the river are presented first, and the tributaries in regular order from source to mouth follow, the streams in each tributary basin being listed before those of the next basin below.

In exception to this rule the records for Mississippi River are given in four parts, as indicated on page VI, and the records for large lakes taken up are in order of streams around the rim of the lake.

Part III. OHIO RIVER BASIN.

PRINCIPAL STREAMS.

The Ohio River basin includes Ohio River with all its tributaries, the most important being Allegheny, Monongahela, Beaver, Muskingum, New (or Kanawha), Scioto, Miami, Kentucky, Wabash, Cumberland, and Tennessee rivers. The streams drain parts of the States of Alabama, Georgia, Illinois, Indiana, Kentucky, Maryland, Mississippi, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia.

In addition to the list of gaging stations and the annotated list of publications relating specifically to the Ohio River basin, the following pages contain a similar list of reports that are of general interest in many sections and cover a wide range of hydrologic subjects, and also brief references to reports published by State and other organizations. (See pp. xix–xx.)

GAGING STATIONS.

NOTE.—Dash following a date indicates that the station was being maintained September 30, 1917. Period after date indicates discontinuance.

Allegheny River (head of Ohio River) at Red House, N. Y., 1903–
Allegheny River at Kittanning, Pa., 1904–1913.
Ohio River at Wheeling, W. Va., 1905–6.
  Conewango Creek:
    Chadakoin River (Chatauqua Lake outlet) near Jamestown, N. Y., 1904–5.
  Kiskiminitas River at Avonmore, Pa., 1907–1913.
  Kiskiminitas River at Salina, Pa., 1904–5.
    Blacklick Creek at Blacklick, Pa., 1904–1906; 1907–1913.
  Tygart River (head of Monongahela River) near Dailey, W. Va., 1915–
  Tygart River at Belington, W. Va., 1907–
  Tygart River at Fetterman, W. Va., 1907–
  Monongahela River at Lock 15, Hoult, W. Va., 1915–
  Monongahela River at Morgantown, W. Va., 1914–15.
  Monongahela River at Lock No. 4, Pa., 1886–1905. Flood-stage record only.
    Middle Fork at Midvale, W. Va., 1915–
    Buckhannon River at Hall, W. Va., 1907–1909; 1915–
    West Fork at Butcherville, W. Va., 1915–
    West Fork at Enterprise, W. Va., 1907–
      Elk Creek near Clarksburg, W. Va., 1910–
    Buffalo Creek at Barrackville, W. Va., 1907–8; 1915–
    Deckers Creek at Morgantown, W. Va., 1914–15.
    Cheat River near Parsons, W. Va., 1913–
    Cheat River at Rowlesburg, W. Va., 1912–
    Cheat River near Morgantown, W. Va., 1899–1900; 1902–1905; 1908–
      Blackwater River at Hendricks, W. Va., 1911–
      Shavers Fork at Parsons, W. Va., 1910–
      Big Sandy Creek at Rockville, W. Va., 1909–

Ohio River tributaries—Continued.
  Monongahela River tributaries—Continued.
    Youghiogheny River at Friendsville, Md., 1898–1904.
    Youghiogheny River at Confluence, Pa., 1904–1913.
      Casselman River at Markleton, Pa., 1913.
      Casselman River at Confluence, Pa., 1904–1913.
        Laurel Hill Creek at Ursina, Pa., 1913.
        Laurel Hill Creek at Confluence, Pa., 1904–1913.
      Indian Creek in Westmoreland County, Pa., 1892–93.
  Beaver River at Wampum, Pa., 1914.
    Mahoning River at Youngstown, Ohio, 1903–1906.
    Conoquenessing Creek near Ellwood, Pa., 1914.
  Little Beaver River near East Liverpool, Ohio, 1915–
  Yellow Creek at Hammondsville, Ohio, 1915–
  Cross Creek near Mingo Junction, Ohio, 1903.
  McMahon River at Steel, Ohio, 1903.
  Middle Island Creek at Little, W. Va., 1915–
  Little Muskingum River at Fay, Ohio, 1915–
  Muskingum River at Zanesville, Ohio, 1905–1912.
  Muskingum River at Frazier, Ohio, 1915–
  Muskingum River at Beverly, Ohio, 1915–
    Mohican River at Pomerene, Ohio, 1910–1913.
    Licking River at Pleasant Valley, Ohio, 1902–1906.
    Jonathan Creek at Powells, Ohio, 1902–3.
  Little Kanawha River at Glenville, W. Va., 1915–
  Little Kanawha River at Lock 4, Palestine, W. Va., 1915–
    South Fork of Hughes River at Macfarlan, W. Va., 1915–
    Hughes River at Cisko, W. Va., 1915–
  Hocking River at Athens, Ohio, 1915–
  New River, South Fork (head of New River, which in turn is head of Kanawha River) at New River, N. C., 1900–1901.
  New River, South Fork, near Crumpler, N. C., 1908–1916.
  New River near Oldtown, Va., 1900–1903.
  New River near Grayson, Va., 1908–1912.
  New River at Radford, Va., 1898–1906; 1907–1915.
  New River at Eggleston, Va., 1914–
  New River at Fayette, W. Va., 1895–1901; 1902–1904; 1908–1916.
  Kanawha River at Lock 2, Montgomery, W. Va., 1915–
    North Fork of New River, near Crumpler, N. C., 1908–1916.
    North Fork of New River at Weaversford, N. C., 1900–1901.
    Reed Creek at Grahams Forge, Va., 1908–1916.
    Big Reed Island Creek near Allisonia, Va., 1908–1916.
    Little River near Copper Valley, Va., 1908–1916.
    Walker Creek at Staffordsville, Va., 1908–1916.
    Wolf Creek near Narrows, Va., 1908–1916.
    Bluestone River at Lilly, W. Va., 1908–1916.
    Bluestone River near True, W. Va., 1911–12.
    Greenbrier River near Marlinton, W. Va., 1908–1916.
    Greenbrier River at Alderson, W. Va., 1895–1906; 1907–
    Gauley River at Allingdale, W. Va., 1908–1916.
    Gauley River near Summersville, W. Va., 1908–1916.
    Gauley River near Belva, W. Va., 1908–1916.
      Cherry River at Richwood, W. Va., 1908–1916.
      Meadow River near Russellville, W. Va., 1908–1916.

- Ohio River tributaries—Continued.
  - Kanawha River tributaries—Continued.
    - Elk River at Webster Springs, W. Va., 1908–1916.
    - Elk River at Gassaway, W. Va., 1908–1916.
    - Elk River at Clendenin, W. Va., 1908–1916.
    - Coal River at Brushton, W. Va., 1908–1916.
    - Coal River at Fuqua, W. Va., 1911–1916.
    - Coal River at Tornado, W. Va., 1908–1912.
      - Little Coal River at McCorkle, W. Va., 1915–
    - Pocotalico River at Sissonville, W. Va., 1908–1916.
  - Raccoon Creek at Adamsville, Ohio, 1915–
  - Guyandot River at Wilber, W. Va., 1915–
  - Guyandot River at Branchland, W. Va., 1915–
    - Mud River at Yates, W. Va., 1915–
  - Twelvepole Creek at Wayne, W. Va., 1915–
  - Levisa Fork (head of Big Sandy River) at Thelma, Ky., 1915–
    - Tug Fork at Kermit, W. Va., 1915–
    - Blaine Creek at Yatesville, Ky., 1915–
  - Scioto River near Columbus, Ohio, 1898–1901; 1903–1906.
  - Scioto River at Chillicothe, Ohio, 1914.
  - Scioto River at Waverly, Ohio, 1916–
    - Olentangy River near Columbus, Ohio, 1898–1901; 1903–1906.
  - Little Miami River near Morrow, Ohio, 1903.
  - Little Miami River at Loveland, Ohio, 1906.
  - Little Miami River at Miamiville, Ohio, 1915–
  - Little Miami River at Plainville, Ohio, 1914–1915.
    - East Fork Little Miami River at Perintown, Ohio, 1915–
  - Licking River at Farmers, Ky., 1915–
  - Licking River at Falmouth, Ky., 1914–1916.
  - Licking River at Catawba, Ky., 1916–
  - Licking River at Morning View, Ky., 1916.
    - South Fork of Licking River at Hayes, Ky., 1916–
    - South Fork of Licking River at Falmouth, Ky., 1915–16.
  - Mill Creek at Arlington Heights, Ohio, 1912–1916.
  - Mill Creek at Cincinnati, Ohio, 1912–13.
  - Miami River at Sidney, Ohio, 1914–
  - Miami River at Piqua, Ohio, 1913–
  - Miami River at Tadmor, Ohio, 1914–
  - Miami River at Dayton, Ohio, 1905–1909; 1913–
  - Miami River at Franklin, Ohio, 1916–
  - Miami River at Hamilton, Ohio, 1910–
  - Miami River at Venice, Ohio, 1915–
    - Loramie Creek at Lockington, Ohio, 1915–
    - Stillwater River at Pleasant Hill, Ohio, 1916–
    - Stillwater River near West Milton, Ohio, 1914–
    - Mad River near Springfield, Ohio, 1904–1906; 1914–
    - Mad River near Dayton, Ohio, 1914–
      - Buck Creek at Springfield, Ohio, 1914–
    - Twin Creek near Germantown, Ohio, 1914–
    - Fourmile Creek near Sevenmile, Ohio, 1914–
      - Sevenmile Creek at Sevenmile, Ohio, 1914–
    - Whitewater River at Brookville, Ind., 1915–
  - Kentucky River at Frankfort, Ky., 1905–6.
    - Dix River near Danville, Ky., 1905–6.
    - Dix River near Burgin, Ky., 1910–
    - Elkhorn Creek at Forks of Elkhorn, Ky., 1915–
    - Eagle Creek at Glencoe, Ky., 1915–

Ohio River tributaries—Continued.
- Rolling Fork of Salt River (head of Salt River) at New Haven, Ky., 1905–6.
- Green River at Munfordville, Ky., 1915–
- Wabash River at Logansport, Ind., 1903–1906.
- Wabash River at La Fayette, Ind., 1901–1903.
- Wabash River at Terre Haute, Ind., 1902–1904; 1905–6.
- Wabash River at Mount Carmel, Ill., 1909–1913.
  - Eel River at Logansport, Ind., 1903.
  - Tippecanoe River at Springboro, near Delphi, Ind., 1903–1906; 1908.
  - Vermilion River near Danville, Ill., 1914–
  - Embarrass River near Oakland, Ill., 1909–1912; 1914–15.
  - Embarrass River at Ste. Marie, Ill., 1909–1912; 1914–
  - White River, West Branch (head of White River) near Noblesville, Ind., 1915–
  - White River, West Branch at Indianapolis, Ind., 1904–1906.
    - Eel River at Cataract, Ind., 1903–1906.
    - East Branch of White River at Shoals, Ind., 1903–1906; 1909–1916.
  - Little Wabash River near Clay City, Ill., 1908–1912.
  - Little Wabash River at Wilcox, Ill., 1914–
  - Little Wabash River near Golden Gate, Ill., 1908–1912.
  - Little Wabash River at Carmi, Ill., 1908–1912.
    - Skillet Fork at Wayne City, Ill., 1908–1912; 1914–
    - Skillet Fork near Mill Shoals, Ill., 1908–1912.
- Cumberland River at Cumberland Falls, Ky., 1907–1911; 1915–
- Cumberland River at Burnside, Ky., 1915–
- Cumberland River at Nashville, Tenn., 1902–1904.
  - South Fork of Cumberland River at Nevelsville, Ky., 1915–
  - Caney Fork near Rock Island, Tenn., 1911–
    - Collins River near Rowland, Tenn., 1916–
- French Broad River (head of Tennessee River) at Rosman, N. C., 1907–1909.
- French Broad River at Horseshoe, N. C., 1904–1906.
- French Broad River at Asheville, N. C., 1895–
- French Broad River at Oldtown, near Newport, Tenn., 1900–1905; 1907.
- Tennessee River at Knoxville, Tenn., 1900–1912.
- Tennessee River at Chattanooga, Tenn., 1873–1913; 1915–
- Tennessee River at Florence, Ala., 1871–
- Tennessee River at Johnsonville, Tenn., 1875–
  - Davidson River near Davidson River, N. C., 1904–1909.
  - Little River at Calhoun, N. C., 1907–8.
  - Mills River, South Fork (head of Mills River), near Sitton, N. C., 1904–1909.
    - North Fork of Mills River at Pinkbed, N. C., 1904–1909.
  - Mud Creek at Naples, N. C., 1907.
  - Swannanoa River at Swannanoa, N. C., 1907–1909.
  - Swannanoa River at Biltmore, N. C., 1904.
  - Ivy River at Democrat, N. C., 1907.
  - Pigeon River at Canton, N. C., 1907–1909.
  - Pigeon River at Newport, Tenn., 1900–1901; 1903–1905; 1906–1909.
  - Nolichucky River at Chucky Valley, Tenn., 1900–1901.
  - Nolichucky River at Greenville, Tenn., 1903–1908.
    - North Toe River at Spruce Pine, N. C., 1907–8.
  - Holston River, South Fork (head of Holston River), near Chilhowie, Va., 1907–1909.
  - Holston River, South Fork, at Bluff City, Tenn., 1900–
  - Holston River near Rogersville, Tenn., 1902–
    - Middle Fork of Holston River at Chilhowie, Va., 1907–1909.
    - Watauga River at Butler, Tenn., 1900–1901.
    - Watauga River near Elizabethton, Tenn., 1903–1908.
      - Elk Creek at Lineback, Tenn., 1900–1901.

Ohio River tributaries—Continued.
 Tennessee River tributaries—Continued.
  Holston River tributaries—Continued.
   Roane Creek at Butler, Tenn., 1900–1901.
   Doe River at Blevins, Tenn., 1911–1915.
   Doe River at Valley Forge, Tenn., 1911–1916.
   Doe River at Elizabethton, Tenn., 1907–8; 1912.
   North Fork of Holston River at Saltville, Va., 1907–8.
  Little Tennessee River near Franklin, N. C., 1907–1910.
  Little Tennessee River at Judson, N. C., 1896–
  Little Tennessee River at McGhee, Tenn., 1905–1914.
   Cullasagee River at Cullasagee, N. C., 1907–1909.
   Nantahala River near Nantahala, N. C., 1907–1909.
   Tuckasegee River near East Laport, N. C., 1907–1909.
   Tuckasegee River at Bryson, N. C., 1897–
    Scott Creek near Dillsboro, N. C., 1907–8.
    Oconalufty River near Cherokee, N, C., 1907–8.
   Cheoah River at Millsaps, N. C., 1907–8.
  Clinch River at Clinchport, Va., 1907–1909.
  Hiwassee River near Hayesville, N. C., 1907–1909.
  Hiwassee River at Murphy, N. C., 1896–1917.
  Hiwassee River at Reliance, Tenn., 1900–1913.
  Hiwassee River at Charleston, Tenn., 1899–1902.
   Tusquitee Creek near Hayesville, N. C., 1907–1909.
   Valley River at Tomotla, N. C., 1904–1909; 1914–1917.
   Nottely River near Ranger, N. C., 1901–1905; 1914–1917.
   Toccoa River (head of Ocoee River) near Dial, Ga., 1907–8; 1913–
   Toccoa River near Morganton, Ga., 1898–1903; 1913–
   Ocoee River at McCays (Copper Hill), Tenn., 1903–1913.
   Ocoee River at McHarge, Tenn., 1917–
   Ocoee River at Emf, Tenn., 1913–
   Ocoee River at Parksville, Tenn., 1911–1916.
  Big Bear River near Red Bay, Ala., 1913–
  Elk River near Elkmont, Ala., 1904–1908.
  Duck River at Columbia, Tenn., 1904–1908.

REPORTS ON WATER RESOURCES OF THE OHIO RIVER BASIN.[1]

PUBLICATIONS OF UNITED STATES GEOLOGICAL SURVEY.

WATER-SUPPLY PAPERS.

Water-supply papers are distributed free by the Geological Survey as long as its stock lasts. An asterisk (*) indicates that this stock has been exhausted. Many of the papers marked in this way may, however, be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C. Water-supply papers are of octavo size.

*21. Wells of northern Indiana, by Frank Leverett. 1899. 82 pp., 2 pls. (Continued in No. 26.)

Discusses by counties the glacial deposits and the sources of well waters; gives many well sections.

*24. Water resources of the State of New York, Part I, by G. W. Rafter. 1899. 99 pp., 13 pls. 15c.

*25. Water resources of the State of New York, Part II, by G. W. Rafter. 1899. 100 pp., 12 pls. 15c.

No. 24 contains descriptions of the principal rivers of New York and their more important tributaries, and data on temperature, precipitation, evaporation, and stream flow.

No. 25 contains discussion of water-storage projects on Genesee and Hudson rivers, power development at Niagara Falls, descriptions and early history of State canals, and a chapter on the use and value of the water power of the streams and canals: also brief discussion of the water yield of sand areas of Long Island.

[1] For stream-measurement reports see tables on p. VI.

*26. Wells of southern Indiana (continuation of No. 21), by Frank Leverett. 1899. 64 pp. 5c.

Discusses by counties the glacial deposits and the sources of well water; contains many well sections.

*44. Profiles of rivers in the United States, by Henry Gannett. 1901. 100 pp., 11 pls. 15c.

Gives elevations and distances along rivers of the United States, and brief descriptions of many of the streams, including Ohio River and a number of its tributaries.

*57. Preliminary list of deep borings in the United States, Part I (Alabama-Montana), by N. H. Darton. 1902. 60 pp. 5c.

*61. Preliminary list of deep borings in the United States, Part II (Nebraska-Wyoming), by N. H. Darton. 1902. 67 pp. 5c.

A second, revised, edition of Nos. 57 and 61 was published in 1905 as Water-Supply Paper 149 (q. v.).

62. Hydrography of the southern Appalachian Mountain region, Part I, by H. A. Pressey. 1902. 95 pp., 25 pls. 15c.

*63. Hydrography of the southern Appalachian Mountain region, Part II, by H. A. Pressey. 1902. pp. 96–190, pls. 26–44. 15c.

Nos. 62 and 63 describe in a general way the mountains, rivers, climate, forests, soil, vegetation, and mineral resources of the southern Appalachian Mountains, and then discuss in detail the drainage basins, giving for each an account of the physical features, rainfall, forests, minerals, transportation, discharge measurements, and water powers. Most of the streams described are tributary through Tennessee River to the Ohio, but Part II (No. 63) includes also descriptions of several streams in the south Atlantic slope and eastern Gulf of Mexico drainage basins.

79. Normal and polluted waters in northeastern United States, by M. O. Leighton. 1903. 192 pp. 10c.

Defines essential qualities of water for various uses, the impurities in rain, surface, and ground waters, the meaning and importance of sanitary analyses, and the principal sources of pollution; chiefly "a review of the more readily available records" of examination of water supplies derived from streams in the Merrimack, Connecticut, Housatonic, Delaware, and Ohio, River basins; contains many analyses.

91. The natural features and economic development of the Sandusky, Maumee, Muskingum, and Miami drainage areas in Ohio, by B. H. and M. S. Flynn. 1904. 130 pp. 10c.

Describes the topography, geology, and soils of the areas and discusses stream flow, dams, water powers, and public water supplies.

96. Destructive floods in the United States in 1903, by E. C. Murphy. 1904. 81 pp., 13 pls. 15c.

Contains notes on early floods in Mississippi Valley.

102. Contributions to the hydrology of eastern United States, 1903; M. L. Fuller, geologist in charge. 1904. 522 pp. 30c.

Contain brief reports on springs and wells of Alabama, Georgia, Tennessee, and Kentucky. The reports comprise tabulated well records giving information as to location, owner, depth, yield, head, etc., supplemented by notes as to elevation above sea, materials penetrated, temperature, use and quality; many miscellaneous analyses.

*103. A review of the laws forbidding pollution of inland waters in the United States, by E. B. Goodell. 1904. 120 pp. See 152.

Cites statutory restrictions of water pollution in Alabama, Indiana, Illinois, Kentucky, Maryland, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia.

*107. Water powers of Alabama, with an appendix on stream measurements in Mississippi, by B. M. Hall. 1904. 253 pp., 9 pls. 20c.

Contains gage heights, rating tables, estimates of monthly discharge at stations on Tallapoosa, Coosa, Alabama, Cahaba, Black Warrior, Tombigbee, and Tennessee rivers and their tributaries; gives estimates and short descriptions of water powers.

110. Contributions to the hydrology of eastern United States, 1904; M. L. Fuller. geologist in charge. 1905. 211 pp., 5 pls. 10c. Contains:

Water resources of the Middlesboro-Harlan region of southeastern Kentucky, by George H. Ashley. Describes topographic features of the area and the water supply of Middlesboro and Pineville.

Water resources of the Cowee and Pisgah quadrangles, North Carolina, by Hoyt S. Gale. Discusses drainage, springs, and waters of one of the units of the geologic atlas of the United States.

113. The disposal of strawboard and oil-well wastes, by R. L. Sackett and Isaiah Bowman. 1905. 52 pp., 4pls. 5c.

Contains a brief report on the topography, drainage, geology, and the pollution of wells and streams by oil waste and brine in an area drained by Mississinewa River, a tributary of the Wabash.

*114. Underground waters of eastern United States; M. L. Fuller, geologist in charge, 1905. 285 pp., 18 pls. 25c.

Contains brief reports relating to Ohio River drainage areas, as follows:
Tennessee and Kentucky, by L. C. Glenn.
Ohio, by Frank Leverett.
Illinois, by Frank Leverett.
West Virginia, by M. L. Fuller.
Indiana, by Frank Leverett.
North Carolina, by M. L. Fuller.
South Carolina, by L. C. Glenn.
Georgia, by S. W. McCallie.
Alabama, by E. A. Smith.

Each of these reports describes the geology of the area in its relation to water supplies, notes the principal mineral springs, and gives list of pertinent publications.

115. River surveys and profiles made during 1903. arranged by W. C. Hall and J. C. Hoyt. 1905. 115 pp.,4 pls. 10c.

Contains results of surveys made to determine location of undeveloped power sites. Gives elevations and distances along Hiwassee, Nottely, and Toccoa rivers.

144. The normal distribution of chlorine in the natural waters of New York and New England, by D. D. Jackson. 1905. 31 pp., 5 pls. 10c.

Discusses common salt in coast and inland waters, salt as an index to pollution of streams and wells, the solutions and methods used in chlorine determinations, and the use of the normal chlorine map; gives charts and tables for chlorine in the New England States and New York.

145. Contributions to the hydrology of eastern United States, 1905; M. L. Fuller, geologist in charge. 1905. 220 pp., 6 pls. 10c.

Contains "Water resources of the Nicholas quadrangle, West Virginia," by George H. Ashley Describes topography, geology, and domestic water supply of the hilly region in central West Virginia, a little east of New and Kanawha rivers.

147. Destructive floods in United States in 1904, by E. C. Murphy and others. 1905. 206 pp., 18 pls. 15c.

Describes Wabash River flood, Indiana, causes of flood discharge, damage, and prevention of damage; also the drought in the Ohio River basin, its causes and effects; flood in Scottdale Valley, caused by failure of dam on Jacobs Creek (tributary to the Ohio through Youghiogheny River).

*149. Preliminary list of deep borings in the United States, second edition with additions, by N. H. Darton. 1905. 175 pp. 10c.

Gives by States (and within the States by counties); location, depth, diameter, yield, height of water, and other valuable information concerning wells 400 feet or more in depth; includes all wells listed in Water-Supply Papers 57 and 61; mentions also principal publications relating to deep borings.

*152. A review of the laws forbidding pollution of inland waters in the United States (second edition), by E. B. Goodell. 1905. 149 pp. 10c.

Cites statutory restrictions of water pollution in Alabama, Illinois, Indiana, Kentucky, Maryland, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia.

159. Summary of the underground-water resources of Mississippi, by A. F. Crider and L. C. Johnson. 1906. 86 pp., 6 pls. 20c.

Describes geography, topography, and general geology of the State; discusses the source, depth of penetration, rate of percolation, and recovery of ground waters; artesian requisites, and special conditions in the Coastal Plain formations; gives notes on wells by counties, deep-well records, and selected records in detail; treats of sanitary aspect of wells and gives analyses.

*162. Destructive floods in the United States in 1905, with a discussion of flood discharge and frequency and an index to flood literature, by E. C. Murphy and others. 1906. 105 pp., 4 pls. 15c.

Gives accounts of floods on Allegheny and Ohio rivers, and estimates of flood discharge and frequency on Monongahela, Youghiogheny, and Tennessee rivers.

*164. Underground waters of Tennessee and Kentucky west of Tennessee River and of an adjacent area in Illinois, by L. C. Glenn. 1906. 173 pp., 7 pls. 25c.

Describes static level and uses of waters, artesian conditions, and source and properties of ground water; discusses topography, geology, and water resources by counties; gives logs of wells, analyses of waters, and bibliography of most important reports.

*197. Water resources of Georgia, by B. M. and M. R. Hall. 1907. 342 pp., 1 pl. 50c.

Describes topographic and geologic features of the State; discusses by drainage basins stream flow, river surveys, and water powers.

*233. Water resources of the Blue Grass region, Kentucky, by G. C. Matson, with a chapter on the quality of the waters, by Chase Palmer. 1909. 223 pp., 3 pls. 20c.

Describes the geologic formations, physiographic features, soils, and surface waters of the region; the source, conditions of occurrence, amount and recovery of the ground waters, collection and storage of rain water, municipal water supplies, and conditions in each county; discusses under "Quality" the industrial uses of the water, comparative hardness, and mineral and table waters; many analyses.

236. The quality of surface waters in the United States, Part I, Analyses of waters east of the one hundredth meridian, by R. B. Dole. 1909. 123 pp. 10c.

Describes collection of samples, method of examination, preparation of solutions, accuracy of estimates, and expression of analytical results; gives results of analyses of waters of Allegheny, Cumberland, Kentucky, Miami, Wabash, and Tennessee rivers and some of their tributaries.

*239. The quality of the surface waters of Illinois, by W. D. Collins. 1910. 94 pp., 3 pls. 10c.

Discusses the natural and economic features that determine the character of the streams; describes the larger drainage basins and the methods of collecting and analyzing the samples of water, and discusses each river in detail with reference to its source, course, and quality of water; includes short chapters on municipal supplies and industrial uses.

254. The underground waters of north-central Indiana, by S. R. Capps, with a chapter on the chemical character of the waters, by R. B. Dole. 1910. 279 pp., 7 pls. 40c.

Describes relief, drainage, vegetation, soils, and crops, industrial development, and geologic formations; source, movements, occurrence and volume of ground water: methods of well construction and lifting devices: discusses in detail for each county surface features and drainage; geology and ground water, city, village, and rural supplies, and gives records of wells and analyses of waters. Discusses also, under chemical character, methods of analyses and expression of results, mineral constituents, effect of the constituents on waters for domestic, industrial, and medicinal uses, methods of purification, chemical composition; many analyses and field assays

259. The underground waters of southwestern Ohio, by M. L. Fuller and F. G. Clapp, with a discussion of the chemical character of the waters, by R. B. Dole. 1912. 228 pp., 9 pls. 35c.

Describes the topography, climate, and geology of the region, the water-bearing formations, the source, mode of occurrence, and head of the waters, and municipal supplies; gives details by counties; discusses in supplement, under chemical character, method of analyses and expression of results, mineral constituents, effect of the constituents on waters for domestic, industrial, or medicinal uses, methods of purification, chemical composition; many analyses and field assays. The matter in the supplement was also published in Water-Supply Paper 254 (The underground waters of north-central Indiana).

334. The Ohio Valley flood of March-April, 1913 (including comparisons with some earlier floods), by A. H. Horton and H. J. Jackson. 1913. 96 pp., 22 pls. 20c.

Although relating specifically to floods in the Ohio Valley, this report discusses also the causes of floods and the prevention of damage by floods.

*364. Water analyses from the laboratory of the United States Geological Survey, tabulated by F. W. Clarke, chief chemist. 1914. 40 pp. 5c.

Contains analyses of spring and well waters from Pennsylvania, West Virginia, Kentucky, Tennessee, and Illinois, and of mine waters from Ducktown, Tenn.

ANNUAL REPORTS.

Each of the papers contained in the annual reports was also issued in separate forms.

Annual reports are distributed free by the Geological Survey as long as its stock lasts. An asterisk (*) indicates that this stock has been exhausted. Many of the papers so marked, however, may be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C.

Fourteenth Annual Report of the United States Geological Survey, 1892–93, J. W. Powell, Director. 1893. (Pt. II, 1894.) 2 parts. *Pt. II. Accompanying papers, pp. xx, 597, 73 pls. $2.10. Contains:

*The potable waters of the eastern United States, by W. J. McGee, pp. 1–47. Discusses cistern water, stream waters, and ground waters, including mineral springs and artesian wells.

Seventeenth Annual Report of the United States Geological Survey, 1895–96, Charles D. Walcott, Director. 1896. 3 parts in 4 vols. *Pt. II. Economic geology and hydrography, pp. xxv, 864, 113 pls. $2.35. Contains:

*The water resources of Illinois, by Frank Leverett, pp. 695–849, pls. 106 to 113. Describes the physical features of the State, and the drainage basins, including tributaries of the Mississippi in western Illinois, and tributaries of the Wabash; discusses the rainfall and run-off, navigable waters and water powers, the wells supplying water for rural districts, and artesian wells; contains tabulated artesian well data and water analyses.

Eighteenth Annual Report of the United States Geological Survey, 1896–97, Charles D. Walcott, Director. 1897. (Pts. II and III, 1898.) 5 parts in 6 vols. *Pt. IV, Hydrography, pp. x, 756, 102 pls. $1.75. Contains:

*The water resources of Indiana and Ohio, by Frank Leverett, pp. 419–560, pls. 33 to 37. Describes the Wabash, Whitewater, Great Miami, Little Miami, Scioto, Hocking, Muskingum, and Beaver rivers and lesser tributaries of the Ohio in Indiana and Ohio, the streams discharging into Lake Erie and Lake Michigan, and streams flowing to the upper Mississippi through the Illinois; discusses shallow and drift wells, the flowing wells from the drift and deeper artesian wells, and gives records of wells at many of the cities; describes the mineral springs, and gives analyses of the waters; contains also tabulated lists of cities using surface waters for waterworks, and of cities and villages using shallow and deep well waters; discusses the source and quality of the city and village supplies; and gives precipitation tables for various points.

Nineteenth Annual Report of the United States Geological Survey, 1897–98, Charles D. Walcott, Director. 1898. (Pts. II, III, and V, 1899.) 6 parts in 7 vols. and separate case for maps with Pt. V. *Pt. IV, Hydrography, pp. viii, 814, 118 plates. $1.85. Contains:

*The rock waters of Ohio, by Edward Orton, pp. 633–717, pls. 71 to 73. Describes the principal geologic formations of Ohio and the waters from the different strata; discusses the flowing wells at various points and the artesian wells of pre-Glacial channels in Allen, Auglaize, and Mercer counties; discusses city and village supplies; gives analyses of waters from various formations.

MONOGRAPHS.

Monographs are of quarto size. They are not distributed free, but may be obtained from the Geological Survey or from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C., at the prices indicated. An asterisk (*) indicates that the Survey's stock of the paper is exhausted.

41. Glacial formations and drainage features of the Erie and Ohio basins, by Frank Leverett. 1902. 802 pp., 26 pls. $1.75.

Treats of an area extending westward from Genessee Valley in New York across northwestern Pennsylvania and Ohio, central and southern Indiana, and southward from Lakes Ontario and Erie to the vicinity of Allegheny and Ohio rivers.

PROFESSIONAL PAPERS.

Professional papers are distributed free by the Geological Survey as long as its stock lasts. An asterisk (*) indicates that this stock has been exhausted. Many of the papers marked with an asterisk may, however, be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C. Professional papers are of quarto size.

*37. The southern Appalachian forests, by H. B. Ayres and W. W. Ashe. 1905. 291 pp., 37 pls. 80c.

Describes the relief, drainage, climate, natural resources, scenery, and water supply of the southern Appalachian forests, the trees, shrubs, and rate of growth; gives details concerning forests by drainage basins, including New, Holston (southern tributaries of South Fork only) Watauga, Nolichucky, French Broad, Pigeon, Little Tennessee, Hiwassee, Tallulah-Chatooga Toxaway, Saluda, and First and Second Broad rivers, Catawba and Yadkin rivers, describing many of the tributaries of each of the master streams.

*72. Denudation and erosion in the southern Appalachian region and the Monongahela basin, by L. C. Glenn. 1911. 137 pp., 21 pls. 35c.

Describes the topography, geology, drainage, forests, climate and population, and transportation facilities of the region, the relation of agriculture, lumbering, mining, and power development to erosion and denudation, and the nature, effects, and remedies of erosion; gives details of conditions in Holston, Nolichucky, French Broad, Little Tennessee, and Hiwassee river basins, along Tennessee River proper, and in the basins of the Coosa-Alabama system, Chattahoochee, Savannah, Saluda, Broad, Catawba, Yadkin, New, and Monongahela rivers.

BULLETINS.

An asterisk (*) indicates that the Geological Survey's stock of the paper is exhausted. Many of the papers so marked may be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C. Bulletins are of octavo size.

*264. Record of deep-well drilling for 1904, by M. L. Fuller, E. F. Lines, and A. C. Veatch. 1905. 106 pp. 10c.

Discusses the importance of accurate well records to the driller, to owners of oil, gas, and water wells, and to the geologist; describes the general method of work; gives tabulated records of wells in Illinois, Indiana, New York, Ohio, Pennsylvania, Tennessee, West Virginia, and Kentucky, and detailed records of wells in Delaware and Jay counties, Ind.; Greene, Warren, and Washington counties, Pa.; and Kanawha, Ritchie, and Wetzel counties, W. Va. These records were selected because they give definite stratigraphic information.

*298. Record of deep-well drilling for 1905, by M. L. Fuller and Samuel Sanford. 1906. 299 pp. 25c.

Gives an account of progress in the collection of well records and samples; contains tabulated records of wells in Alabama, Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia, and detailed records of wells in Madison County, Ala., Crawford County, Ill.; Delaware, Martin, Randolph, and Vanderburg counties, Ind.; Hopkins and Metcalfe counties, Ky.; Hocking, Noble, Tuscarawas, and Wayne counties, Ohio; Armstrong, Greene, Somerset, Warren, and Washington counties, Pa.; and Cabell, Harrison, Marion, Monongalia, Wayne, and Wetzel counties, W. Va. The wells of which detailed records are given were selected because they afford definite stratigraphic information.

GEOLOGIC FOLIOS.

Under the plan adopted for the preparation of a geologic map of the United States the entire area is divided into small quadrangles, bounded by certain meridians and parallels, and these quadrangles, which number several thousand, are separately surveyed and mapped.[1] The unit of survey is also the unit of publication, and the maps and description of each quadrangle are issued in the form of a folio. When all the folios are completed they will constitute the Geologic Atlas of the United States.

A folio is designated by the name of the principal town or of a prominent natural feature within the quadrangle. Each folio includes maps showing the topography, geology, underground structure, and mineral deposits of the area mapped and several pages of descriptive text. The text explains the maps and describes the topographic

[1] Index maps showing areas in the Ohio River basin covered by topographic maps and by geologic folios will be mailed on receipt of request addressed to the Director, U. S. Geological Survey, Washington, D. C.

and geologic features of the country and its mineral products. The topographic map shows roads, railroads, waterways, and, by contour lines, the shapes of the hills and valleys and the height above sea level of all points in the quadrangle. The areal-geology map shows the distribution of the various rocks at the surface. The structural-geology map shows the relations of the rocks to one another underground. The economic-geology map indicates the location of mineral deposits that are commercially valuable. The artesian-water map shows the depth to underground-water horizons. Economic-geology and artesian-water maps are included in folios if the conditions in the areas mapped warrant their publication. The folios are of special interest to students of geography and geology and are valuable as guides in the development and utilization of mineral resources.

The folios numbered from 1 to 163, inclusive, are published in only one form (18 by 22 inches), called the library edition. Some of the folios that bear numbers higher than 163 are published also in an octavo edition (6 by 9 inches). Owing to a fire in the Geological Survey building May 18, 1913, the stock of geologic folios was more or less damaged by fire and water, but many of the folios were usable. They are sold at the uniform price of 5 cents each, with no reduction for wholesale orders. This rate applies to folios in stock from 1 to 184, inclusive (except reprints); also to the library edition of folio 186. The library edition of folios 185, 187, and higher numbers sells for 25 cents a copy, except that some folios which contain an unusually large amount of matter sell at higher prices. The octavo edition of folio 185 and higher numbers sell for 50 cents a copy, except folio 193, which sells for 75 cents a copy. A discount of 40 per cent is allowed on an order for folios or for folios together with topographic maps amounting to $5 or more at the retail rate.

All the folios contain descriptions of the drainage of the quadrangles. The folios in the following list contain also brief discussions of the underground waters in connection with the economic resources of the areas and more or less information concerning the utilization of the water resources.

An asterisk (*) indicates that the stock of the folio is exhausted.

*16. Knoxville folio, Tennessee-North Carolina.

*67. Danville folio, Illinois-Indiana.

Discusses the shallow dug or open wells, the tubular wells, and the flowing wells; gives also tabulated data concerning depth, head, water-bearing bed, etc., of the wells in the quadrangle.

84. Ditney folio, Indiana. 5c.

90. Cranberry folio, North Carolina-Tennessee.

102. Indiana folio, Pennsylvania. 5c.

Indicates promising localities for artesian water.

105. Patoka folio, Indiana-Illinois. 5c.

Discusses the water supply of the streams, springs, wells, cisterns, and artificial ponds.

*121. Waynesburg folio, Pennsylvania.

123. Elders Ridge, Pennsylvania. 5c.

*124. Mount Mitchell, North Carolina-Tennessee.

Describes water powers and the various sources of water used for industrial and domestic supplies.

*144. Amity, Pennsylvania.

Gives a brief discussion of the water supply of the town of Washington.

*146. Rogersville, Pennsylvania.

*147. Pisgah, North Carolina-South Carolina.

*151. Roan Mountain, Tennessee-North Carolina.

*160. Accident-Grantsville, Maryland-Pennsylvania-West Virginia.

Notes possibility of obtaining artesian water.

172. Warren,[1] Pennsylvania-New York. 5c.
*174. Johnstown,[1] Pennsylvania. 5c.
Describes the city water supply at Johnstown and the water resources of the quadrangle in general.
176. Sewickley, Pennsylvania. 5c.
*177. Burgettstown-Carnegie,[2] Pennsylvania.
Contains partial well records.
180. Claysville, Pennsylvania. 5c.
184. Kenova, Kentucky-West Virginia-Ohio. 5c.
187. Ellijay, Georgia-North Carolina-Tennessee. 25c.
Contains brief paragraph on water power.
189. Barnesboro-Patton, Pennsylvania. 25c.
197. Columbus, Ohio. Library edition, 25c.; octavo edition, 50c.
Gives brief description of the water supply of Columbus and analyses of the mineral content of the water of Scioto River.

MISCELLANEOUS REPORTS.

Other Federal bureaus and State and other organizations have from time to time published reports relating to the water resources of the various sections of the country. Notable among those pertaining to the Ohio River basin are the reports of the Chief of Engineers, United States Army; the State geological surveys of Alabama, Illinois, Kentucky, North Carolina, Tennessee, and Virginia; the Illinois Water-Supply Commission and the Rivers and Lakes Commission of Illinois; the New York State Conservation Commission and State Water-Supply Commission; the Water-Supply Commission of Pennsylvania and the Pittsburgh Flood Commission; and the water-power report of the Tenth Census (vol. 17). The following reports deserve special mention.

The Mississippi and Ohio rivers, by Charles H. Ellet. 1853.

Report upon the physics and hydraulics of the Mississippi River, by A. A. Humphreys and H. L. Abbot. 1861.

Preliminary report on a part of the water powers of Alabama, by B. M. Hall: Alabama Geol. Survey Bull. 7, 1903.

The underground water resources of Alabama, by Eugene A. Smith: Alabama Geol. Survey Mon. 6, 1907.

Preliminary report on a part of the water powers of Georgia, compiled by B. M. Hall: Georgia Geol. Survey Bull. 3 A, 1896.

Preliminary report on the underground waters of Georgia, by S. W. McCallie: Georgia Geol. Survey Bull. 15, 1908.

The mineral content of Illinois waters, by Edward Bartow, J. A. Udden, S. W. Parr, and George T. Palmer: Illinois State Geol. Survey Bull. 10, 1909.

Chemical survey of the waters of Illinois, report for the years 1897-1902, by A. W. Palmer, with Geology of Illinois as related to its water supply, by Charles W. Rolfe: University of Illinois publications.

Chemical and biological survey of waters of Illinois, by Edward Bartow: University of Illinois publications 3, 6, 7, 1906-1909.

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[1] Issued in two editions. (See p. xviii.) Specify which edition is wanted.
[2] Library edition out of stock.

Report upon the prevention of overflow of Little Wabash and Skillet Fork rivers, by W. J. McEathron and L. L. Hidinger. Rivers and Lakes Commission, 1911.

Papers on the water power of North Carolina, a preliminary report by George F. Swain: North Carolina Geol. Survey Bull. 8, 1899.

Report of the investigations into the purification of the Ohio River water for the improved water supply of the city of Cincinnati, Ohio; made by the board of trustees, commissioners of waterworks, Cincinnati, 1899.

Progress report on a plan of sewerage for the city of Cincinnati, 1912–13.

The mineral waters of Indiana, their location, origin, and character, by W. S. Blatchley: Indiana Dept. Geology and Nat. Res. Twenty-sixth Ann. Rept., 1901.

Report on the value of the Dix River as a source of water power, by August F. Foerste, and Supplementary report on Dix River, by August F. Foerste: Kentucky Geol. Survey Bull. 21, 1912.

Underground waters of Mississippi, a preliminary report, by W. N. Logan and W. R. Perkins: Mississippi Agr. Exper. Sta. Bull. 89.

Hydrology of the State of New York, by George W. Rafter: New York State Mus. Bull. 85, 1905.

A report to the mayor and city council on flood protection for the city of Columbus, Ohio, 1913.

Report of the filtration commission of the city of Pittsburgh, Pa., 1899.

The water powers of Tennessee, by J. A. Switzer, including a report on Doe River, by A. H. Horton: Tennessee Geol. Survey Bull. 17, 1914.

Hydrography of Virginia, by N. C. Grover and R. H. Bolster: Virginia Geol. Survey Bull. 3, 1906.

Surface water supply of Virginia, by G. C. Stevens: Virginia Geol. Survey Bull. 10, 1916.

Report of the Secretary of Agriculture in relation to the forests, rivers, and mountains of the Southern Appalachian region: 57th Congress, 1st sess., S. Doc. 84, 1902.

Many of these reports can be obtained by applying to the several commissions, and most of them can be consulted in the public libraries of the larger cities.

GEOLOGICAL SURVEY HYDROLOGIC REPORTS OF GENERAL INTEREST.

The following list comprises reports not readily classifiable by drainage basins and covering a wide range of hydrologic investigations:

WATER-SUPPLY PAPERS.

*1. Pumping water for irrigation, H. M. Wilson. 1896. 57 pp., 9 pls.

Describes pumps and motive powers, windmills, water wheels, and various kinds of engines; also storage reservoirs to retain pumped water until needed for irrigation.

*3. Sewage irrigation, by G. W. Rafter. 1897. 100 pp., 4 pls. (See Water-Supply Paper 22.) 10c.

Discusses methods of sewage disposal by intermittent filtration and by irrigation; describes utilization of sewage in Germany, England, and France, and sewage purification in the United States.

*8. Windmills for irrigation, by E. C. Murphy. 1897. 49 pp., 8 pls. 10c.

Gives results of experimental tests of windmills during the summer of 1896 in the vicinity of Garden, Kans.; describes instruments and methods and draws conclusions.

*14. New tests of certain pumps and water lifts used in irrigation, by O. P. Hood. 1898. 91 pp., 1 pl.

Discusses efficiency of pumps and water lifts of various types.

*20. Experiments with windmills, by T. O. Perry. 1899. 97 pp., 12 pls. 15c.

Includes tables and descriptions of wind wheels, compares wheels of several types, and discusses results.

*22. Sewage irrigation, Part II, by G. W. Rafter. 1899. 100 pp., 7 pls. 15c.

Gives résumé of Water-Supply Paper 3; discusses pollution of certain streams, experiments on purification of factory wastes in Massachusetts, value of commercial fertilizers, and describes American sewage-disposal plants by States; contains bibliography of publications relating to sewage utilization and disposal.

*41. The windmill: Its efficiency and economic use, Part I, by E. C. Murphy. 1901. 72 pp., 14 pls. 5c.

*42. The windmill: Its efficiency and economic use, Part II, by E. C. Murphy. 1901. 75 pp. (73–147), 2 pls. (15–16). 10c.

Nos. 41 and 42 give details of results of experimental tests with windmills of various types.

*43. Conveyance of water in irrigation canals, flumes, and pipes, by Samuel Fortier. 1901. 86 pp., 15 pls. 15c.

*56. Methods of stream measurement. 1901. 51 pp., 12 pls. 15c.

Describes the methods used by the Survey in 1901–2. (See also Nos. 64, 94, and 95.)

*64. Accuracy of stream measurements, by E. C. Murphy. 1902. 99 pp., 4 pls. (See No. 95.) 10c.

Describes methods of measuring velocity of water and of measuring and computing stream flow and compares results obtained with the different instruments and methods; describes also experiments and results at the Cornell University hydraulic laboratory. A second, enlarged edition published as Water-Supply Paper 95.

*67. The motions of underground waters, by C. S. Slichter. 1902. 106 pp., 8 pls. 15c.

Discusses origin, depth, and amount of ground waters; permeability of rocks and porosity of soils; causes, rates, and laws of motions of ground water; surface and deep zones of flow, and recovery of waters by open wells and artesian and deep wells; treats of the shape and position of the water table; gives simple methods of measuring yields of flowing wells; describes artesian wells at Savannah, Ga.

72. Sewage pollution in the metropolitan area near New York City and its effect on inland water resources, by M. O. Leighton. 1902. 75 pp., 8 pls. 10c.

Defines "normal" and "polluted" waters and discusses the damages resulting from pollution.

*80. The relation of rainfall to run-off, by G. W. Rafter. 1903. 104 pp. 10c.

Treats of measurements of rainfall and laws and measurements of stream flow; gives rainfall, run-off, and evaporation formulas; discusses effects of forests on rainfall and run-off.

87. Irrigation in India (second edition), by H. M. Wilson. 1903. 238 pp., 27 pls. 25c.

First edition was published in Part II of the Twelfth Annual Report.

93. Proceedings of first conference of engineers of Reclamation Service, with accompanying papers, compiled by F. H. Newell, chief engineer. 1904. 361 pp. 25c. [Requests for this report should be addressed to the United States Reclamation Service.]

Contains, the following papers of more or less general interest:
Limits of an irrigation project, by D. W. Ross.
Relation of Federal and State laws to irrigation, by Morris Bien.
Electrical transmission of power for pumping, by H. A. Storrs.
Correct design and stability of high masonary dams, by George Y. Wisner.
Irrigation surveys and the use of the plane table, by J. B. Lippincott.
The use of alkaline waters for irrigation, by Thomas H. Means.

*94. Hydrographic manual of the United States Geological Survey, prepared by E. C. Murphy, J. C. Hoyt, and G. B. Hollister. 1904. 76 pp., 3 pls. 10c.

Gives instruction for field and office work relating to measurements of stream flow by current meters. (See also No. 95.)

*95. Accuracy of stream measurements (second, enlarged edition), by E. C. Murphy. 1904. 169 pp., 6 pls.

Describes methods of measuring and computing stream flow and compares results derived from different instruments and methods. (See also No. 94.)

*103. A review of the laws forbidding pollution of inland waters in the United States, by E. B. Goodell. 1904. 120 pp. (See No. 152.)

Explains the legal principles under which antipollution statutes become operative, quotes court decisions to show authority for various deductions, and classifies according to scope the statutes enacted in the different States.

110. Contributions to the hydrology of eastern United States, 1904; M. L. Fuller, geologist in charge. 1905. 211 pp., 5 pls. 10c.

Contains the following reports of general interest. The scope of each paper is indicated by its title.
Description of underflow meter used in measuring the velocity and direction of underground water, by Charles S. Slichter.
The California or "stovepipe" method of well construction, by Charles S. Slichter.
Approximate methods of measuring the yield of flowing wells, by Charles S. Slichter.
Corrections necessary in accurate determination of flow from vertical well casings, from notes furnished by A. N. Talbot.
Experiment relating to problems of well contamination at Quitman, Ga., by S. W. McCallie.

113. The disposal of strawboard and oil-well wastes, by R. L. Sackett and Isaiah Bowman. 1905. 52 pp., 4 pls. 5c.

The first paper discusses the pollution of streams by sewage and by trade wastes, describes the manufacture of strawboard and gives results of various experiments in disposing of the waste. The second paper describes briefly the topography, drainage, and geology of the region about Marion, Ind., the contamination of rock wells and of streams by waste-oil and brine.

*114. Underground waters of eastern United States; M. L. Fuller, geologist in charge. 1905. 285 pp., 18 pls. 25c.

Contains report on "Occurrence of underground waters," by M. L. Fuller, discussing sources, amount, and temperature of waters, permeability and storage capacity of rocks, water-bearing formations, recovery of water by springs, wells, and pumps, essential conditions of artesian flows, and general conditions affecting ground waters in eastern United States.

119. Index to the hydrographic progress reports of the United States Geological Survey, 1888 to 1903, by J. C. Hoyt and B. D. Wood. 1905. 253 pp. 15c.

120. Bibliographic review and index of papers relating to underground waters published by the United States Geological Survey, 1879–1904, by M. L. Fuller. 1905. 128 pp. 10c.

*122. Relation of the law to underground waters, by D. W. Johnson. 1905. 55 pp. 5c.

Defines and classifies underground waters, gives common-law rules relating to their use, and cites State legislative acts affecting them.

140. Field measurements of the rate of movement of underground waters, by C. S. Slichter. 1905. 122 pp., 15 pls. 15c.

Discusses the capacity of sand to transmit water, describes measurements of underflow in Rio Hondo, San Gabriel, and Mohave River valleys, Calif., and on Long Island, N. Y.; gives results of tests of wells and pumping plants, and describes stovepipe method of well construction.

143. Experiments on steel-concrete pipes on a working scale, by J. H. Quinton. 1905. 61 pp., 4 pls. 5c.

Scope indicated by title.

145. Contributions to the hydrology of eastern United States, 1905; M. L. Fuller, geologist in charge. 1905. 220 pp., 6 pls. 10c.

Contains brief reports of general interest as follows:

Drainage of ponds into drilled wells, by Robert E. Horton. Discusses efficiency, cost, and capacity of drainage wells, and gives statistics of such wells in southern Michigan.

Construction of so-called fountain and geyser springs, by Myron L. Fuller.

A convenient gage for determining low artesian heads, by Myron L. Fuller.

146. Proceedings of second conference of engineers of the Reclamation Service with accompanying papers, compiled by F. H. Newell, chief engineer. 1905. 267 pp. 15c. [Requests for this report should be addressed to the United States Reclamation Service.]

Contains brief account of the organization of the hydrographic [water resources] branch and the Reclamation Service, reports of conferences and committees, circulars of instruction, and many brief reports on subjects closely related to reclamation, and a bibliography of techinical papers by members of the service. Of the papers read at the conference those listed below (scope indicated by title) are of more or less general interest:

Proposed State code of water laws, by Morris Bien.
Power engineering applied to irrigation problems, by O. H. Ensign.
Estimates on tunneling in irrigation projects, by A. L. Fellows.
Collection of stream-gaging data, by N. C. Grover.
Diamond-drill methods by G. A. Hammond.
Mean-velocity and area curves, by F. W. Hanna.
Importance of general hydrographic data concerning basins of streams gaged, by R. E. Horton.
Effect of aquatic vegetation on stream flow, by R. E. Horton.
Sanitary regulations governing construction camps, by M. O. Leighton.
Necessity of draining irrigated land, by Thomas H. Means.
Alkali soils, by Thomas H. Means.
Cost of stream-gaging work, by E. C. Murphy.
Equipment of a cable gaging station, by E. C. Murphy.
Silting of reservoirs, by W. M. Reed.
Farm-unit classification, by D. W. Ross.
Cost of power for pumping irrigating water, by H. A. Storrs.
Records of flow of current-meter gaging stations during the frozen season, by F. H. Tillinghast.

147. Destructive floods in United States in 1894, by E. C. Murphy and others. 206 pp., 18 pls. 15c.

Contains a brief account of "A method of computing cross-section area of waterways," including formulas for maximum discharge and areas of cross section.

*150. Weir experiments, coefficients, and formulas, by R. E. Horton. 1906. 189 pp., 38 pls. (See Water-Supply Paper 200.) 15c.

Scope indicated by title.

151. Field assay of water, by M. O. Leighton. 1905. 77 pp., 4 pls.

Discusses methods, instruments, and reagents used in determining turbidity, color, iron, chlorides, and hardness in connection with the studies of the quality of water in various parts of the United States.

*152. A review of the laws forbidding pollution of inland waters in the United States, second edition, by E. B. Goodell. 1905. 149 pp. 10c.

Scope indicated by title.

*155. Fluctuations of the water level in wells, with special reference to Long Island, N. Y., by A. C. Veatch. 1906. 83 pp., 9 pls. 25c.

Includes general discussion of fluctuations due to rainfall and evaporation, barometric changes, temperature changes, changes in rivers, changes in lake level, tidal changes, effects of settlement, irrigation, dams, ground-water developments, and to indeterminate causes.

*160. Underground-water papers; M. L. Fuller, geologist in charge. 1906. 104 pp., 1 pl.

Gives account of work in 1905, lists of publications relating to ground waters, and contains the following brief reports of general interest:

Significance of the term "artesian," by Myron L. Fuller.
Representation of wells and springs on maps, by Myron L. Fuller.
Total amount of free water in the earth's crust, by Myron L. Fuller.
Use of fluorescein in the study of underground water, by R. B. Dole.
Problems of water contamination, by Isaiah Bowman.
Instances of improvement of water in wells, by Myron L. Fuller.

*162. Destructive floods in the United States in 1905, with a discussion of flood discharge and frequency and an index to flood literature, by E. C. Murphy and others. 1906. 105 pp., 4 pls. 15c.

*163. Bibliographic review and index of underground-water literature published in the United States in 1905, by M. L. Fuller, F. G. Clapp, and B. L. Johnson. 1906. 130 pp. 15c.

Scope indicated by title.

*179. Prevention of stream pollution by distillery refuse, based on investigations at Lynchburg, Ohio, by Herman Stabler. 1906. 34 pp., 1 pl. 10c.

Describes grain distillation, treatment of slop, sources, character, and effects of effluents on streams; discusses filtration, precipitation, fermentation, and evaporation methods of disposal of wastes without pollution.

*180. Turbine water-wheel tests and power tables, by R. E. Horton. 1906. 134 pp., 2 pls. 20c.

Scope indicated by title.

*185. Investigations on the purification of Boston sewage, * * * with a history of the sewage problem, by C.-E. A. Winslow and E. B. Phelps. 1906. 163 pp. 25c.

Discusses composition, disposal, purification, and treatment of sewages and tendencies in sewage-disposal practice in England, Germany, and the United States; describes character of crude sewage at Boston, removal of suspended matter, treatment in septic tanks, and purification in intermittent sand filtration and coarse material; gives bibliography.

*186. Stream pollution by acid-iron wastes: a report based on investigations made at Shelby, Ohio, by Herman Stabler. 1906. 36 pp., 1 pl.

Gives history of pollution by acid-iron wastes at Shelby, Ohio, and resulting litigation; discusses effect of acid-iron liquors on sewage purification processes, recovery of copperas from acid-iron wastes, and other processes for removal of pickling liquor.

*187. Determination of stream flow during the frozen season, by H. K. Barrows and R. E. Horton. 1907. 93 pp., 1 pl.

Scope indicated by title.

*189. The prevention of stream pollution by strawboard waste, by E. B. Phelps. 1906. 29 pp., 2 pls.

Describes manufacture of strawboard, present and proposed methods of disposal of waste liquors, laboratory investigations of precipitation and sedimentation, and field studies of amounts and character of water used, raw material and finished product, and mechanical filtration.

*194. Pollution of Illinois and Mississippi rivers by Chicago sewage (a digest of the testimony taken in the case of the State of Missouri *v.* The State of Illinois and the Sanitary District of Chicago), by M. O. Leighton. 1907. 369 pp., 2 pls.

Scope indicated by amplification of title.

*200. Weir experiments, coefficients, and formulas (revision of paper No. 150), by R. E. Horton. 1907. 195 pp., 38 pls. 35c.

Scope indicated by title.

*226. The pollution of streams by sulphite-pulp waste, a study of possible remedies, by E. B. Phelps. 1908. 37 pp., 1 pl. 10c.

Describes manufacture of sulphite pulp, the waste liquors, and the experimental work leading to suggestions as to methods of preventing stream pollution.

*229. The disinfection of sewage and sewage filter effluents, with a chapter on the putrescibility and stability of sewage effluents, by E. B. Phelps. 1909. 91 pp., 1 pl. 15c.

Scope indicated by title.

*234. Papers on the conservation of water resources. 1909. 96 pp., 2 pls. 15c.

Contains the following papers, whose scope is indicated by their titles: Distribution of rainfall, by Henry Gannett; Floods, by M. O. Leighton; Developed water powers, compiled under the direction of W. M. Steuart, with discussion by M. O. Leighton; Undeveloped water powers, by M. O. Leighton; Irrigation, by F. H. Newell; Underground waters, by W. C. Mendenhall; Denudation, by R. B. Dole and Herman Stabler; Control of catchment areas, by H. N. Parker.

*235. The purification of some textile and other factory wastes, by Herman Stabler and G. H. Pratt. 1909. 76 pp. 10c.

Discusses waste waters from wool scouring, bleaching and dyeing cotton yarn, bleaching cotton piece goods, and manufacture of oleomargarine, fertilizer, and glue.

236. The quality of surface waters in the United States: Part I.—Analyses of waters east of the one hundredth meridian, by R. B. Dole. 1909. 123 pp. 10c.

Describes collection of samples, method of examination, preparation of solutions, accuracy of estimates, and expression of analytical results.

238. The public utility of water powers and their governmental regulation, by René Tavernier and M. O. Leighton. 1910. 161 pp. 15c.

Discusses hydraulic power and irrigation, French, Italian, and Swiss legislation relative to the development of water powers, and laws proposed in the French Parliament; reviews work of bureau of hydraulics and agricultural improvements of the French department of agriculture, and gives résumé of Federal and State water-power legislation in the United States.

*255. Underground waters for farm use, by M. L. Fuller. 1910. 58 pp., 17 pls. 15c.

Discusses rocks as sources of water supply and the relative safety of supplies from different materials; springs, and their protection; open or dug and deep wells, their location, yield, relative cost, protection, and safety; advantages and disadvantages of cisterns and combination wells and cisterns.

*257. Well-drilling methods, by Isaiah Bowman. 1911. 139 pp., 4 pls. 15c.

Discusses amount, distribution, and disposal of rainfall, water-bearing rocks, amount of ground water, artesian conditions, and oil and gas bearing formations; gives history of well drilling in Asia, Europe, and the United States; describes in detail the various methods and the machinery used; discusses loss of tools and geologic difficulties; contamination of well water and methods of prevention; tests of capacity and measurement of depth; and costs of sinking wells.

*258. Underground-water papers, 1910, by M. L. Fuller, F. G. Clapp, G. C. Matson, Samuel Sanford, and H. C. Wolff. 1911. 135 pp., 2 pls. 15c.

Contains the following papers (scope indicated by titles) of general interest:
Drainage by wells, by M. L. Fuller.
Freezing of wells and related phenomena, by M. L. Fuller.
Pollution of underground waters in limestone, by G. C. Matson.
Protection of shallow wells in sandy deposits, by M. L. Fuller.
Magnetic wells, by M. L. Fuller.

274. Some stream waters of the western United States, with chapters on sediment carried by the Rio Grande and the industrial application of water analyses, by Herman Stabler. 1911. 188 pp. 15c.

Describes collection of samples, plan of analytical work, and methods of analyses; discusses soap-consuming power of waters, water-softening, boiler waters, and waters for irrigation.

*315. The purification of public water supplies, by G. A. Johnson. 1913. 84 pp., 8 pls. 10c.

Discusses ground, lake, and river waters as public supplies, development of waterworks systems in the United States, water consumption, and typhoid fever; describes methods of filtration and sterilization of water, and municipal water softening.

*337. The effects of ice on stream flow, by William Glenn Hoyt. 1913. 71 pp., 7 pls. 15c.

Discusses methods of measuring water flow of streams.

*345. Contributions to the hydrology of the United States, 1914. N. C. Grover, chief hydraulic engineer. 1915. 225 pp., 17 pls. 30c. Contains:

*(e) A method of determining the daily discharge of rivers of variable slope, by M. R. Hall, W. E. Hall, and C. H. Pierce, pp. 53-65.

371. Equipment for current-meter gaging stations, by G. J. Lyon. 1915. 64 pp., 37 pls. 20c.

Describes methods of installing automatic and other gages and of constructing gage wells, shelters, and structures for making discharge measurements and artificial controls.

*375. Contributions to the hydrology of the United States, 1915. N. C. Grover, chief hydraulic engineer. 1916. 181 pp., 9 pls. 15c.

Contains three papers presented at the conference of engineers of the water-resources branch in December, 1914.

*(c) Relation of stream gaging to the science of hydraulics, by C. H. Pierce and R. W. Davenport, pp. 77-84.

(e) A method of correcting river discharge for changing stage, by B. E. Jones, pp. 117-130.

(f) Conditions requiring the use of automatic gages in obtaining stream-flow records, by C. H. Pierce, pp. 131-139.

*400. Contributions to the hydrology of the United States, 1916. N. C. Grover, chief hydraulic engineer. 1917. 108 pp., 7 pls. Contains:

(a) The people's interest in water-power resources, by G. O. Smith, pp. 1-8.

*(c) The measurement of silt-laden streams, by Raymond C. Pierce, pp. 39-51.

(d) Accuracy of stream-flow data, by N. C. Grover and J. C. Hoyt, pp. 53-59.

416. The divining rod, a history of water witching, with a bibliography, by A. J. Ellis. 1917. 59 pp. 10c.

A brief paper published "merely to furnish a reply to the numerous inquiries that are continually being received from all parts of the country" as to the efficacy of the divining rod for locating underground water.

*425. Contributions to the hydrology of the United States, 1917. W. C. Grover, chief hydraulic engineer. 1918. Contains:

*(c) Hydraulic conversion tables and convenient equivalents, pp. 71-94. 1917.

427. Bibliography and index of the publications of the United States Geological Survey relating to ground water, by O. E. Meinzer. 1918. 169 pp., 1 pl.

Includes publications prepared, in whole or part, by the Geological Survey that treat any phase of the subject of ground water or any subject directly applicable to ground water. Illustrated by map showing reports that cover specific areas more or less thoroughly.

ANNUAL REPORTS.

*Fifth Annual Report of the United States Geological Survey, 1883-84, J. W. Powell, Director. 1885. xxxvi, 469 pp., 58 pls. $2.25. Contains:

*The requisite and qualifying conditions of artesian wells, by T. C. Chamberlin, pp. 125-173 pl. 21. Scope indicated by title.

*Twelfth Annual Report of the United States Geological Survey, 1890–91, J. W. Powell, Director. 1891. 2 parts. *Pt. II, Irrigation, xviii, 576 pp., 93 pls. $2. Contains:

*Irrigation in India, by H. M. Wilson, pp. 363–561, pls. 107 to 146. (See Water-Supply Paper 87.)

Thirteenth Annual Report of the United States Geological Survey, 1891–92, J. W. Powell, Director. 1892. (Pts. II and III, 1893.) 3 parts. *Pt. III, Irrigation, xi, 486 pp., 77 pls. $1.85. Contains:

*American irrigation engineering, by H. M. Wilson, pp. 101–349, pls. 111 to 146. Discusses the economic aspects of irrigation, alkaline drainage, silt and sedimentation; gives brief history of legislation; describes perennial canals in Idaho-California, Wyoming, and Arizona; discusses water-storage at reservoirs of the California and other projects, subsurface sources of supply, pumping, and subirrigation.

Fourteenth Annual Report of the United States Geological Survey, 1892–93, J. W. Powell, Director. 1893. (Pt. II, 1894.) 2 parts. *Pt. II, Accompanying papers, xx, 597 pp., 73 pls. $2.10. Contains:

*The potable waters of the eastern United States, by W. J. McGee, pp. 1–47. Discusses cistern water, stream waters, and ground waters, including mineral springs and artesian wells.

*Natural mineral waters of the United States, by A. C. Peale, pp. 49–88, pls. 3 and 4. Discusses the origin and flow of mineral springs, the source of mineralization, thermal springs, the chemical composition and analysis of spring waters, geographic distribution, and the utilization of mineral waters; gives a list of American mineral spring resorts; contains also some analyses.

Nineteenth Annual Report of the United States Geological Survey, 1897–98, Charles D. Walcott, Director. 1898. (Parts II, III, and V, 1899.) 6 parts in 7 vols. and separate case for maps with Pt. V. *Pt. II, Papers chiefly of a theoretic nature, v. 958 pp., 172 pls. $2.65. Contains:

*Principles and conditions of the movements of ground water, by F. H. King, pp. 59–294, pls. 6 to 16. Discusses the amount of water stored in sandstone, in soil, and in other rocks, the depth to which ground water penetrates; gravitational, thermal, and capillary movements of ground waters, and the configuration of the ground-water surface; gives the results of experimental investigations on the flow of air and water through a rigid, porous medium, and through sands, sandstones, and silts; discusses results obtained by other investigators, and summarizes results of observations; discusses also rate of flow of water through sand and rock, the growth of rivers, rate of filtration through soil, interference of wells, etc.

*Theoretical investigation of the motion of ground waters, by C. S. Slichter, pp. 295–384, pl. 17. Scope indicated by title.

PROFESSIONAL PAPERS.

86. The transportation of débris by running water, by G. K. Gilbert, based on experiments made with the assistance of E. C. Murphy. 1914. 263 pp., 3 pls. 70c.

The results of an investigation which was carried on in a specially equipped laboratory at Berkeley, Calif., and was undertaken for the purpose of learning "the laws which control the movement of bed load and especially to determine how the quantity of load is related to the stream slope and discharge and to the degree of comminution of the débris."

A highly technical report.

105. Hydraulic-mining débris in the Sierra Nevada, by G. K. Gilbert. 154 pp., 34 pls. 1917. 50c.

Presents the results of an investigation undertaken by the United States Geological Survey in response to a memorial from the California Miners' Association asking that a particular study be made of portions of the Sacramento and San Joaquin valleys affected by detritus from torrential streams. The report deals largely with geologic and physiographic aspects of the subject, traces the physical effects, past and future, of the hydraulic mining of earlier decades, the similar effects which certain other industries induce through stimulation of the erosion of the soil, and the influence of the restriction of the area of inundation by the construction of levees. Suggests cooperation by several interests for the control of the streams now carrying heavy loads of débris.

BULLETINS.

*32. Lists and analyses of the mineral springs of the United States (a preliminary study), by A. C. Peale. 1886. 235 pp.

Defines mineral waters, lists the springs by States, and gives tables of analyses.

*319. Summary of the controlling factors of artesian flows, by Myron L. Fuller. 1908. 10c.

Describes underground reservoirs, the sources of ground waters, the confining agents, the primary and modifying factors of artesian circulation, the essential and modifying factors of artesian flow, and typical artesian systems.

*479. The geochemical interpretation of water analyses, by Chase Palmer. 1911. 31 pp. 5c.

Discusses the expression of chemical analyses, the chemical character of water, and the properties of natural waters; gives a classification of waters based on property values and reacting values, and discusses the character of the waters of certain rivers as interpreted directly from the results of analyses; discusses also the relation of water properties to geologic formations, silica in river water, and the character of the water of the Mississippi and the Great Lakes and St. Lawrence River as indicated by chemical analyses.

695. The data of geochemistry (fourth edition), by F. W. Clarke. 1920. 832 pp. 45c.

Earlier editions were published as Bulletins 330, 491, and 616. Contains a discussion of the statement and interpretation of water analyses and a chapter on "Mineral wells and springs" (pp. 175–211). Discusses the definition and classification of mineral waters, changes in the composition of water, deposits of calcareous, ocherous, and siliceous materials made by water, vadose and juvenile waters, and thermal springs in relation to volcanism. Describes the different kinds of ground water and gives typical analyses. Includes a brief bibliography of papers containing water analyses.

INDEX BY AREAS AND SUBJECTS.

[A—Annual Reports; M—Monograph; B—Bulletin; P—Professional Paper; W—Water-Supply Paper; G F—Geologic folio.]

[1] Many of the reports contain brief subject bibliographies. See abstracts.
[2] Many analyses of river, spring, and well waters are scattered through publications, as noted in abstracts.

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Paper 454

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DEPARTMENT OF THE INTERIOR
FRANKLIN K. LANE, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

WATER-SUPPLY PAPER 454

SURFACE WATER SUPPLY OF THE UNITED STATES
1917

PART IV. ST. LAWRENCE RIVER BASIN

NATHAN C. GROVER, Chief Hydraulic Engineer

W. G. HOYT, A. H. HORTON, C. C. COVERT, and
C. H. PIERCE, District Engineers

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STATES OF MINNESOTA, WISCONSIN, NEW YORK, AND VERMONT

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CONTENTS.

ILLUSTRATIONS.

SURFACE WATER SUPPLY OF ST. LAWRENCE RIVER BASIN, 1917.

AUTHORIZATION AND SCOPE OF WORK.

This volume is one of a series of 14 reports presenting results of measurements of flow made on streams in the United States during the year ending September 30, 1917.

The data presented in these reports were collected by the United States Geological Survey under the following authority contained in the organic law (20 Stat. L., p. 394):

Provided, That this officer [the Director] shall have the direction of the Geological Survey and the classification of public lands and examination of the geological structure, mineral resources, and products of the national domain.

The work was begun in 1888 in connection with special studies relating to irrigation in the arid West. Since the fiscal year ending June 30, 1895, successive sundry-civil bills passed by Congress have carried the following item and appropriations:

For gaging the streams and determining the water supply of the United States, and for the investigation of underground currents and artesian wells, and for the preparation of reports upon the best methods of utilizing the water resources.

Annual appropriations for the fiscal years ending June 30, 1895–1917.

1895	$12,500
1896	20,000
1897 to 1900, inclusive	50,000
1901 to 1902, inclusive	100,000
1903 to 1906, inclusive	200,000
1907	150,000
1908 to 1910, inclusive	100,000
1911 to 1917, inclusive	150,000

In the execution of the work many private and State organizations have cooperated either by furnishing data or by assisting in collecting data. Acknowledgements for cooperation of the first kind are made in connection with the description of each station affected; cooperation of the second kind is acknowledged on page 9.

Measurements of stream flow have been made at about 4,240 points in the United States and also at many points in Alaska and the Hawaiian Islands. In July, 1917, 1,180 gaging stations were being maintained by the Survey and the cooperating organizations. Many miscellaneous discharge measurements are made at other points. In connection with this work data were also collected in regard to precipitation, evaporation, storage reservoirs, river profiles, and water power in many sections of the country and will be made available in water-supply papers from time to time. Information in regard to publications relating to water resources is presented in the appendix to this report.

DEFINITION OF TERMS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups—(1) those that represent a rate of flow, as second-feet, gallons per minute, miner's inches, and discharge in second-feet per square mile, and (2) those that represent the actual quantity of water, as run-off in depth in inches, acre-feet, and millions of cubic feet. The principal terms used in this series of reports are second-feet per square mile, run-off in inches, and acre-feet. They may be defined as follows:

"Second-feet" is an abbreviation for "cubic feet per second." A second-foot is the rate of discharge of water flowing in a channel of rectangular cross section 1 foot wide and 1 foot deep at an average velocity of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off (depth in inches)" is the depth to which an area would be covered if all the water flowing from it in a given period were uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

An "acre-foot," equivalent to 43,560 cubic feet, is the quantity required to cover an acre to the depth of 1 foot. The term is commonly used in connection with storage for irrigation.

The following terms not in common use are here defined:

"Stage-discharge relation," an abbreviation for the term "relation of gage height to discharge."

"Control," a term used to designate the section or sections of the stream below the gage which determines the stage-discharge relation at the gage. It should be noted that the control may not be the same section or sections at all stages.

The "point of zero flow" for a gaging station is that point on the gage—the gage height—to which the surface of the river would fall if there were no flow.

EXPLANATION OF DATA.

The data presented in this report cover the year beginning October 1, 1916, and ending September 30, 1917. At the first of January in most parts of the United States much of the precipitation in the preceding three months is stored as ground water, in the form of snow, or in ponds, lakes, and swamps, and this stored water passes off in the streams during the spring break-up; at the end of September, on the other hand, the only stored water available for run-off is possibly a small quantity in the ground; therefore the run-off for a year beginning October 1, is practically all derived from precipitation in that year.

The base data collected at gaging stations (Pl. I, *B*) consist of records of stage, measurements of discharge, and general information used to supplement the gage heights and discharge measurements in determining the daily flow. The records of stage are obtained either from direct readings on a staff gage or from a water-stage recorder (Pl. II) that gives a continuous record of the fluctuations. Measurements of discharge are made with a current meter by the general methods outlined in standard textbooks on the measurement of river discharge.

From the discharge measurements rating tables are prepared that give the discharge for any stage, and these rating tables, when applied to the gage heights, give the daily discharge from which the monthly and yearly mean discharge is determined.

The data presented for each gaging station in the area covered by this report comprise a description of the station, a table giving results of discharge measurements, a table showing the daily discharge of the stream, and a table of monthly and yearly discharge and run-off.

If the base data are insufficient to determine the daily discharge, tables giving daily gage heights and results of discharge measurements are published.

The description of the station gives, in addition to statements regarding location and equipment, information in regard to any conditions that may affect the constancy of the stage-discharge relation, covering such subjects as the occurrence of ice, the use of the stream for log driving, shifting of channel, and the cause and effect of backwater; it gives also information as to diversions that decrease the flow at the gage, artificial regulation, maximum and minimum recorded stages, and the accuracy of the records.

The table of daily discharge gives, in general, the discharge in second-feet corresponding to the mean of the gage heights read each day. At stations on streams subject to sudden or rapid dirunal fluctuation the discharge obtained from the rating table and the mean daily gage height may not be the true mean discharge for the day. If such stations are equipped with water-stage recorders the mean daily discharge is obtained by averaging the discharge at regular intervals during the day or by use of the discharge integrator, an instrument operating on the principle of the planimeter and containing as an essential element the rating curve of the station.

In the table of monthly discharge the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest. As the gage height is the mean for the day, it does not indicate correctly the stage when the water surface was at crest height and the corresponding discharge was consequently larger than given in the maximum column. Likewise in the column headed "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow in cubic feet for each second during the month. On this average flow computations recorded in the remaining columns, which are defined on page 6, are based.

ACCURACY OF FIELD DATA AND COMPUTED RESULTS.

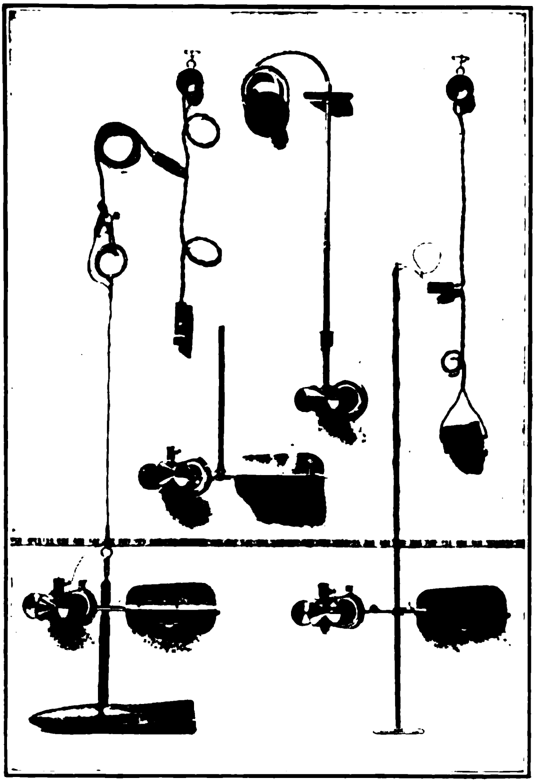
The accuracy of stream-flow data depends primarily (1) on the permanency of the stage-discharge relation and (2) on the accuracy of observation of stage, measurements of flow, and interpretation of records.

A paragraph in the description of the station or footnotes added to the tables gives information regarding the (1) permanence of the stage-discharge relation, (2) precision with which the discharge rating curve is defined, (3) refinement of gage readings, (4) frequency of gage readings, and (5) methods of applying daily gage heights to the rating table to obtain the daily discharge.[1]

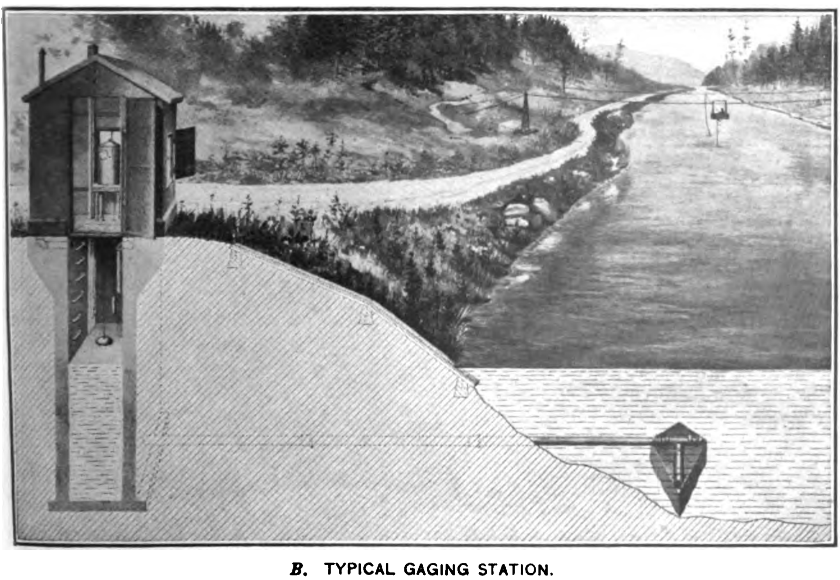
For the rating tables "well defined" indicates, in general, that the rating is probably accurate within 5 per cent; "fairly well defined," within 10 per cent; "poorly defined," within 15 to 25 per cent. These notes are very general and are based on the plotting of the individual measurements with reference to the mean rating curve.

The monthly means for any station may represent with high accuracy the quantity of water flowing past the gage, but the figures showing discharge per square mile and depth of run-off in inches may be subject to gross errors caused by the inclusion of large noncontributing districts in the measured drainage area, by lack of information concerning water diverted for irrigation or other use, or by inability to interpret the effect of artificial regulation of the flow of the river above the station. "Second-feet per square mile" and "run-off (depth in inches)" are therefore not computed if such errors appear probable. The computations are also omitted for

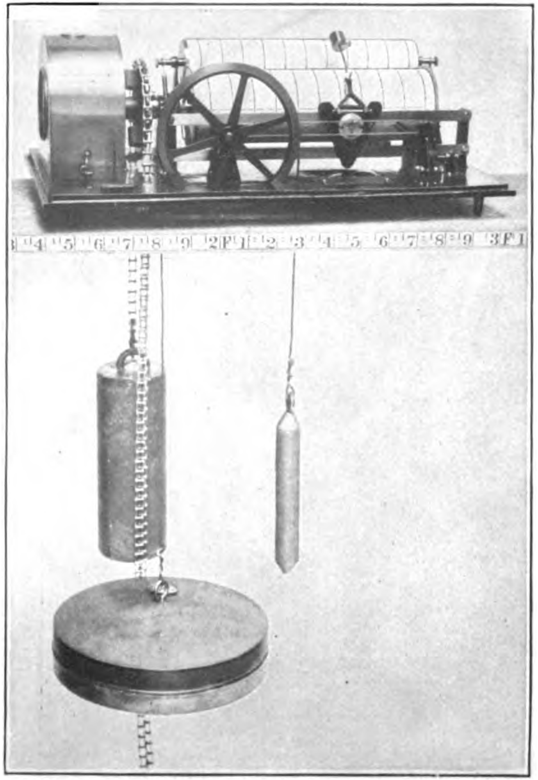
[1] For a more detailed discussion of the accuracy of stream-flow data see Grover, N. C., and Hoyt, J. C., Accuracy of stream-flow data: U. S. Geol. Survey Water-Supply Paper 400, pp. 53–59, 1916.



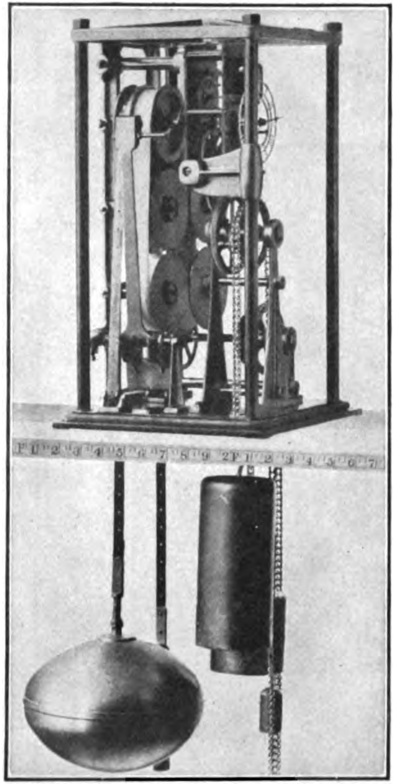
A. PRICE CURRENT METERS.



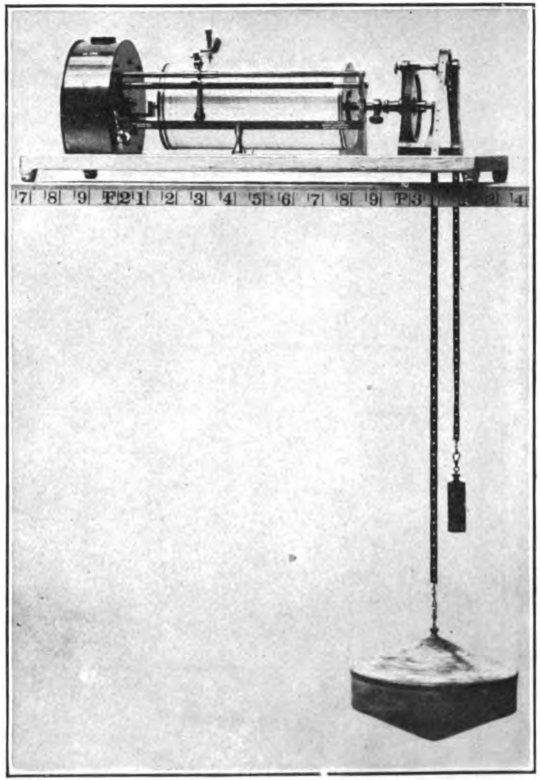
B. TYPICAL GAGING STATION.



A. STEVENS.



B. GURLEY PRINTING.



C. FRIEZ.

WATER-STAGE RECORDERS.

stations on streams draining areas in which the annual rainfall is less than 20 inches. All figures representing "second-feet per square mile" and "run-off (depth in inches)" previously published by the Survey should be used with caution because of possible inherent sources of error not known to the Survey.

The table of monthly discharge gives only a general idea of the flow at the station and should not be used for other than preliminary estimates; the tables of daily discharge allow more detailed studies of the variation in flow. It should be borne in mind, however, that the observations in each succeeding year may be expected to throw new light on data previously published.

COOPERATION.

The work in Minnesota during the year ending September 30, 1917, was done with State cooperation under terms of an act of the legislature of 1909 as embodied in joint resolution 19, which reads as follows:

Whereas the water supplies, water powers, navigation of our rivers, drainage of our lands, and the sanitary condition of our streams and their watersheds generally form one great asset and present one great problem: Therefore be it

Resolved by the house of representatives, the senate concurring, That the State Drainage Commission be, and is hereby, directed to investigate progress in other States toward the solution of said problem in such States, to investigate and determine the nature of said problem in this State.

The work was carried on in conjunction with the State Drainage Commission, E. V. Willard, acting State drainage engineer.

The work in Wisconsin during the year ending September 30, 1917, was done in cooperation with the Railroad Commission of Wisconsin, C. M. Larson, chief engineer, and at certain stations with the following organizations: Menominee & Marinette Light & Traction Co., Edward Daniell, general manager (Menominee River below Koss, Mich.); United States Army Engineer Corps (Wolf River at New London) and Fox River at Rapide Croche Dam; United States Indian Office (Wolf River at Keshenas).

The station on Little Calumet River at Harvey, Ill., was maintained in cooperation with the State of Illinois through the Rivers and Lakes Commission until June 30, 1917, and the Division of Waterways of the Department of Public Works, after that date, and with the sanitary district of Chicago.

The gage reader for Huron River at Flat Rock, Mich., was paid by the Eastern Michigan Edison Co., Washtenaw division, Ann Arbor, Mich.

Work in the State of New York has been conducted under cooperative agreements with the State engineer and surveyor, and since July 1, 1911, with the division of inland waters of the State Conservation Commission as provided by an act of the State legislature.

The water-stage recorder on Genesee River at Rochester, N. Y., was inspected by an employee of the Rochester Railway & Light Co. Water-stage recorder on Raquette River at Piercefield, N. Y., was inspected by an employee of the International Paper Co.

The work in Vermont has been carried on in cooperation with the the State of Vermont, Horace F. Graham, governor, and Herbert M. McIntosh, State engineer, and at certain stations in cooperation with the following organizations and individuals: Vermont Marble Co. (Otter Creek at Middlebury); the department of civil engineering of Norwich University (Dog River at Northfield); Charles T. Middlebrook, consulting engineer, Albany, N. Y. (Green River at Garfield), Newport Electric Light Co. (Clyde River at West Derby).

DIVISION OF WORK.

Data for stations in the Lake Superior and Lake Michigan drainage basins in Minnesota and Wisconsin were collected and prepared for publication under the direction of W. G. Hoyt, district engineer, assisted by S. B. Soulé, H. C. Beckman, E. L. Williams, R. B. Kilgore, F. W. Huels, and J. P. Schwada.

Data for stations in Lake Michigan drainage basins in Illinois were collected and prepared for publication, under the general direction of W. G. Hoyt, district Engineer, by H. C. Beckman, assisted by A. M. Wahl, H. S. Wahl, and Marcia Towle.

For stations in the Lake Huron, the Lake Michigan, and the Lake Erie drainage basins in Michigan, data were collected and prepared for publication under the direction of A. H. Horton, district engineer; assisted by B. J. Peterson.

Data for stations in the St. Lawrence drainage basin in New York were collected and prepared for publication under the direction of C. C. Covert, district engineer, assisted by O. W. Hartwell, E. D. Burchard, A. H. Davison, J. W. Moulton, W. A. James, and Helen Kimmey.

Data for stations in Vermont were collected and prepared for publication under the direction of C. H. Pierce, district engineer, assisted by H. W. Fear, Hardin Thweatt, H. H. Khachadoorian, M. R. Stackpole, and Hope Hearn.

The manuscript was assembled by B. J. Peterson.

GAGING-STATION RECORDS.

STREAMS TRIBUTARY TO LAKE SUPERIOR.

POPLAR RIVER AT LUTSEN, MINN.

LOCATION.—In sec. 34, T. 60 N., R. 3 W., near post office of Lutsen, Cook County, about 750 feet above mouth of river and same distance below State highway bridge.

DRAINAGE AREA.—144 square miles.

RECORDS AVAILABLE.—August 22, 1912, to September 30, 1917, when station was discontinued. May 6 to November 4, 1911 (gage heights only), at point about 350 feet downstream from present site.

GAGE.—Vertical staff bolted to rock wall of right bank of stream, in pool between two distinct falls; read by C. A. A. Nelson. Gage used prior to August 22, 1912, was a vertical staff gage attached to stump on right bank opposite lower point of easterly of two islands that divide flow into three channels. No determined relation between the two gages.

DISCHARGE MEASUREMENTS.—Made by wading or from a boat about 500 feet below the gage.

CHANNEL AND CONTROL.—Crest of falls below gage constitutes control. Channel at this point is solid rock. Banks not subject to overflow. Point of zero flow, gage-height −0.35 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.72 feet at 6 p. m. June 19 (discharge, 756 second-feet); minimum stage recorded, 0.85 foot March 7–22 (discharge, 19 second-feet).

1912–1917: Maximum state recorded, 4.7 feet at 6 p. m. April 25, 1916 (discharge, 1,390 second-feet); minimum stage recorded, 0.80 foot January 4, February 8 and 13, 1913 (discharge, 18 second-feet).

ICE.—Stage-discharge relation not seriously affected by ice; open-channel rating curve assumed applicable.

REGULATION.—Flow in former years controlled to some extent by two dams above the station, the nearest being that of the National Paper & Pulp Co., 2½ miles above mouth of river, but it is believed that the flow for the last three years was entirely natural.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 18 and 1,040 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent.

No discharge measurements were made at this station during the year.

Daily discharge, in second-feet, of Poplar River at Lutsen, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	35	79	36	24	20	20	23	190	280	240	75	39
2	34	78	34	24	20	20	23	228	280	228	62	42
3	34	75	34	24	20	20	23	280	240	215	53	42
4	34	71	34	24	20	20	24	295	190	179	58	42
5	33	70	32	24	20	20	28	295	168	159	114	42
6	31	70	32	24	20	20	30	325	190	265	97	48
7	30	70	33	24	20	19	33	360	360	378	92	48
8	29	70	36	24	20	19	37	378	360	325	114	49
9	28	70	36	24	20	19	43	360	295	265	159	49
10	27	67	36	23	20	19	50	360	240	215	146	44
11	27	66	35	23	20	19	71	342	202	168	126	39
12	27	66	34	23	20	19	83	342	202	168	103	42
13	26	65	34	23	20	19	73	325	190	159	89	50
14	25	62	33	23	20	19	61	325	168	150	78	60
15	25	60	32	22	20	19	53	325	146	143	71	55
16	48	58	32	22	20	19	47	325	139	146	65	49
17	86	55	30	22	20	19	61	310	252	129	59	47
18	59	53	30	22	20	19	70	295	470	114	53	44
19	59	49	29	22	20	19	79	295	695	113	47	44
20	86	47	29	22	20	19	108	280	645	114	42	60
21	79	44	28	22	20	19	134	252	600	106	38	62
22	71	43	27	22	20	19	150	215	510	99	36	55
23	65	43	27	21	20	20	159	202	395	89	48	49
24	59	42	27	21	20	20	159	190	325	80	102	43
25	55	40	27	21	20	20	150	168	325	78	100	37
26	58	40	25	21	20	20	136	159	325	71	83	35
27	65	38	25	20	20	20	146	150	295	61	66	34
28	67	38	25	20	......	21	148	146	265	55	55	35
29	79	38	25	20	......	21	150	134	240	49	46	37
30	83	36	25	20	......	21	168	134	215	55	37	38
31	80	......	24	20	......	22	......	215	......	64	34	......

Monthly discharge of Poplar River at Lutsen, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 144 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	86	25	49.8	0.346	0.40
November	79	36	56.8	.394	.44
December	36	24	30.5	.212	.24
January	24	20	22.3	.155	.18
February	20	20	20.0	.139	.14
March	22	19	19.6	.136	.16
April	168	23	84.0	.583	.65
May	378	134	265	1.84	2.12
June	695	139	307	2.13	2.38
July	378	49	151	1.05	1.21
August	159	34	75.7	.526	.61
September	62	34	45.3	.315	.35
The year	695	19	94.2	.654	8.88

WHITEFACE RIVER BELOW MEADOWLANDS, MINN.

LOCATION.—In sec. 26, T. 53 N., R. 19 W., in St. Louis County, half a mile below beginning of a decided rapids, 1½ miles below Duluth, Missabe & Northern Railway bridge; 2½ miles below highway bridge on line between secs. 14 and 23, T. 53 N., R. 19 W., at which station on Whiteface River at Meadowlands was located; 4 miles below mouth of Little Whiteface River, which enters from left, and 8 miles above confluence of Whiteface and St. Louis Rivers.

DRAINAGE AREA.—446 square miles.

RECORDS AVAILABLE.—April 28, 1912, to September 30, 1917, when station was discontinued. Records June 7, 1909, to Nov. 9, 1912, collected at the station at Meadowlands, 2½ miles upstream.

GAGE.—Chain gage attached to a horizontal timber fastened to two trees on left bank of river, near residence of A. A. Jochim; used for all readings since November 8, 1914; read by A. A. Jochim. Chain gage attached to a horizontal timber fastened to two trees on the same bank but 300 feet upstream from the present gage was used from April 28, 1912, to November 7, 1914. Present gage was set so as to read the same as the former one at a stage of 2.85 feet.

DISCHARGE MEASUREMENTS.—Made from the Duluth, Missabe & Northern Railway bridge or by wading near gage.

CHANNEL AND CONTROL.—Bed of stream consists of heavy gravel and rock; practically permanent. Right bank is rather low and is overflowed at extremely high stages; left bank high and not subject to overflow. A decided rapids a short distance below the gage constitutes the control. Another rapids, above the gage, is frequently obstructed by logs, but when there is sufficient water to carry them over this rapid they are generally carried also over the lower rapids, so that the control is seldom obstructed.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.05 feet July 21 (discharge, 589 second-feet); minimum stage recorded, 1.98 feet at 7 p. m. September 26 (discharge, about 27 second-feet).

1909–1917: Maximum stage recorded, 12.0 feet April 21, 1916 (discharge, 5,880 second-feet); minimum stage recorded, 1.6 feet at 8.20 a. m. August 31, 1916 (discharge 15 second-feet). Open-water periods only; minimum flow probably much lower at times during the winter.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during the winter.

REGULATION.—Flow controlled to a large extent by logging dams above the stations. Operation of gates to these dams causes a fluctuation in stage of several feet at the gaging station.

ACCURACY.—Stage-discharge relation probably permanent except as affected by logs and ice. Two rating curves used, one, applicable October 1 to November 18, 1916, fairly well defined above 92 second-feet; the other, applicable April 15 to September 30, 1917, poorly defined throughout. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Mean daily gage height, as determined from two readings daily subject to some error on account of rather rapid fluctuation in stage occasioned by regulation of flow for log driving. Open-water records at medium and high stage fair to good; low-water records subject to error.

Discharge measurements of Whiteface River below Meadowlands, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
June 26[a]	S. B. Soulé	3.40	322
Sept. 15	R. B. Kilgore	2.47	68

[a] Made from Duluth, Missabe & Northern Railway bridge.

Daily discharge, in second-feet, of Whiteface River near Meadowlands, Minn., for period Aug. 29, 1916, to Sept. 30, 1917.

Day.	Aug.	Sept.	Day.	Aug.	Sept.	Day.	Aug.	Sept.
1916.			1916—Contd.			1916—Contd.		
1		78	11		239	21		254
2		74	12		254	22		196
3		82	13		254	23		196
4		65	14		254	24		196
5		67	15		320	25		210
6		79	16		338	26		224
7		117	17		338	27		196
8		196	18		286	28		170
9		224	19		270	29	117	146
10		224	20		254	30	136	136
						31	43	

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1916-17.								
1	108	170		195	144	93	168	93
2	78	183		122	74	195	254	102
3	117	210		156	93	224	239	102
4	100	210		394	144	84	195	156
5	117	183		394	182	93	182	93
6	117	196		286	112	239	168	93
7	108	183		476	182	133	182	84
8	108	146		320	78	112	210	93
9	108	196		270	82	144	286	70
10	100	183		224	144	182	254	133
11	100	210		168	133	102	224	84
12	100	210		93	144	102	254	78
13	91	108		60	156	156	210	68
14	85	108		93	210	156	210	73
15	82	183	144	122	82	102	168	82
16	86	85	144	82	84	224	168	102
17	91	84	168	112	133	122	133	84
18	92	71	182	71	112	144	133	73
19	73		195	84	122	102	112	59
20	84		286	112	168	270	112	46
21	117		434	102	112	520	82	35
22	158		356	122	270	320	93	35
23	196		356	79	239	356	84	31
24	126		434	112	182	254	79	31
25	108		338	93	133	254	63	30
26	117		356	70	303	210	60	28
27	158		338	68	210	93	63	29
28	170		303	64	168	144	76	34
29	196		286	73	270	195	102	41
30	239		434	82	195	168	84	47
31	183			122		224	84	

NOTE.—Daily-discharge record in the above table, Aug. 29 to Sept. 30, 1916, supersedes that published in Water-Supply Paper 434, p. 16. Gage-height observations, Nov. 19 to Apr. 14, discontinued because of ice.

Monthly discharge of Whiteface River below Meadowlands, Minn., for the period Aug. 1, 1916, to Sept. 30, 1917.

[Drainage area, 446 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1916.					
August	136	46	81.4	0.183	0.21
September	338	67	198	.444	.50
October	239	73	120	.269	.31
November 1-18	210	71	162	.363	.24
1917.					
April 15-30	434	144	297	.666	.40
May	476	60	156	.350	.40
June	303	74	155	.348	.39
July	520	84	184	.413	.48
August	286	60	153	.343	.40
September	156	28	70.3	.158	.18

NOTE.—Records of monthly discharge for August and September, 1916, supersede those published in Water-Supply Paper 434, p. 16.

CLOQUET RIVER AT INDEPENDENCE, MINN.

LOCATION.—In sec. 26, T. 52 N., R. 17 W., at highway bridge at Independence, St. Louis County, just below small tributary entering from right.

DRAINAGE AREA.—698 square miles.

RECORDS AVAILABLE.—June 28, 1909, to September 30, 1917, when station was discontinued.

GAGE.—Chain gage attached to upstream handrail of bridge, near left bank of stream; read by Theodore Haakensen. Gage used prior to October 13, 1915, was a vertical staff attached to upstream end of an old log bulkhead, immediately under the bridge and at the left bank.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading about one-fourth mile below gage.

CHANNEL AND CONTROL.—Heavy gravel and rock; practically permanent. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.4 feet October 19 (discharge, 3,650 second-feet); minimum stage recorded, 4.08 feet April 16, 17, 18 (discharge, about 78 second-feet).

1909–1917: Maximum stage recorded, 9.58 feet June 1, 1911 (discharge, 6,010 second-feet); minimum stage recorded, 3.90 feet July 20, 21, 22, 1911 (discharge, 54 second-feet). The Great Northern Power Co. reported there was no discharge from Fish Lake and Island Lake reservoirs April 6–20 and December 1, 1915; discharge at Independence estimated at 10 second-feet.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during the winter. Since January, 1913, the determination of monthly mean discharge during winter periods has been based on discharge at outlet of Fish Lake reservoir on Cloquet River, in sec. 15, T. 52 N., R. 15 W., and from Island Lake reservoir on the Beaver River, in sec. 29, T. 52 N., R. 15 W.

REGULATION.—Cloquet River is used extensively for log driving, and the run-off from the greater part of the drainage area above Independence is controlled by logging dams. The operation of these dams causes rapid fluctuations in stage which may amount to several feet in 24 hours.

ACCURACY.—Stage-discharge relation permanent except as affected by ice and possibly by logs. Two rating curves used during year, both well defined between 128 and 4,690 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Mean daily gage height determined from two readings daily subject to considerable error on account of rapid fluctuation in stage occasioned by regulation of flow for log driving; records are therefore only roughly approximate to fair.

COOPERATION.—Records of flow from logging reservoirs December 9 to April 7 furnished by Great Northern Power Co., of Duluth.

Discharge measurements of Cloquet River at Independence, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
June 25[a]	S. B. Soulé	5.36	456
Sept. 14	R. B. Kilgore	5.05	304

[a] A few logs near left bank.

Daily discharge, in second-feet, of Cloquet River at Independence, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	613	526	613					189	295	93	665	355
2	613	472	613					162	333	109	772	233
3	676	526	613					175	355	93	450	248
4	584	584	676					150	295	93	530	248
5	554	554	676				200	175	248	86	377	218
6	709	584	676					175	295	80	355	233
7	812	584	613					175	263	93	248	248
8	1,040	644	644				139	150	175	93	162	333
9	1,600	613					139	139	109	93	118	295
10	3,050	584					150	139	162	101	109	263
11	2,040	613					128	139	263	109	128	295
12	961	676					109	118	233	109	162	355
13	176	709					109	109	203	109	150	333
14	254	812					109	118	248	109	150	295
15	446	848			500		93	101	150	118	150	295
16	291	1,040		600		480	80	93	128	109	150	263
17	422	1,040					80	93	128	109	2,520	233
18	446	644					80	93	109	109	2,280	189
19	3,650	676	830				86	101	150	109	3,050	139
20	3,490	613					139	93	248	189	3,050	128
21	2,780	613					189	93	314	175	2,400	139
22	1,210	676					203	86	377	189	314	189
23	613	777					175	80	263	175	150	218
24	709	812					203	80	333	150	109	203
25	613	742					218	80	450	109	109	279
26	613	777					175	86	450	86	109	425
27	613	812					128	101	333	80	109	475
28	644	644					139	118	189	93	118	355
29	709	613					175	175	109	109	139	401
30	644	613					175	263	101	162	203	295
31	554	......					......	295	......	203	425	......

NOTE.—Stage-discharge relation affected by ice Dec. 9 to Apr. 7; gage readings discontinued; discharge estimated from records of discharge from Fish Lake and Island Lake reservoirs.

Monthly discharge of Cloquet River at Independence, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 698 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	3,650	176	1,040	1.49	1.72
November	1,040	472	681	.976	1.09
December			781	1.12	1.29
January			600	.860	.99
February			500	.716	.75
March			480	.688	.79
April		80	154	.221	.25
May	295	80	134	.192	.22
June	450	101	244	.350	.39
July	203	80	118	.169	.19
August	3,050	109	637	.913	1.05
September	475	128	273	.391	.44
The year	3,650	80	471	.675	9.17

BRULE RIVER NEAR BRULE, WIS.

Location.—About sec. 26, T. 48 N., R. 10 W., at Brule Outing Club, Douglas County, 4½ miles downstream from Brule and 9 miles above mouth of river.

Drainage area.—162 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

Records available.—March 19, 1914, to February 28, 1917, when station was discontinued.

Gage.—Vertical staff; low-water section, reading from 0 to 7.9 feet, fastened to downstream side of Brule Outing Club boat landing; high-water section, reading from 8.0 to 9.9 feet, fastened to tree on shore end of landing; read by Charles Leppanen.

Discharge measurements.—Made from a boat held in place by a wire across the river below the gage, or by wading. All measurements are made about 200 feet below gage section.

Channel and control.—Bed composed of gravel. One channel at all stages. Control formed by head of rapids below gage. Banks wooded; not subject to overflow.

Extremes of discharge.—Maximum stage recorded during year, 3.18 feet October 21 (discharge, 220 second-feet); minimum discharge, February 28, 134 second-feet (determined by current-meter measurement).

1914–1917: Maximum stage recorded, 6.2 feet April 21, 1916 (discharge, 1,490 second-feet); minimum stage recorded, 2.75 feet at 7 a. m. March 20, 1914 (discharge, 115 second-feet).

Ice.—Stage-discharge relation affected by ice.

Regulation.—None.

Accuracy.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 145 and 1,370 second-feet. Gage read once daily, to quarter-tenths. Daily discharge ascertained by applying daily gage height to rating table, except for periods when stage-discharge relation was affected by ice, for which periods it was obtained by applying to rating curve daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good; winter records fair.

Discharge measurements of Brule River near Brule, Wis., during the year ending Sept. 30, 1917.

[Made by R. B. Kilgore.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Dec. 27 [a]	4.62	207
Jan. 26 [a]	4.08	136
Feb. 28 [a]	4.23	134

[a] Complete ice cover.

Daily discharge, in second-feet, of Brule River near Brule, Wis., for the period Oct. 1, 1915, to Feb. 28, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Day.	Oct.	Nov.	Dec.	Jan.	Feb.
1	170	195	170			16	170	180	145		
2	170	195	170			17	170	180	145		
3	170	195	170			18	170	175	145		
4	170	195	170			19	195	175	145		
5	170	195	170			20	220	170	145		
6	170	195	170			21	220	170	145		
7	170	195	170			22	208	170	160		135
8	170	195	170	175	135	23	195	170	170		
9	170	195	170			24	195	170	170	140	
10	170	195	170			25	195	170	180		
11	170	195	170			26	195	170	195		
12	170	105	170			27	195	170	205		
13	170	190	160			28	195	170	205		
14	170	185	160			29	195	170	195		
15	170	185	145			30	195	170	195		
						31	195	......	195		

NOTE.—Stage-discharge relation affected by ice Nov. 12 to Feb. 28, when station was discontinued.

Monthly discharge of Brule River near Brule, Wis., for the period Oct. 1, 1916, to Feb. 28, 1917.

[Drainage area 162 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	220	170	183	1.13	1.30
November	195	170	183	1.13	1.26
December	205	145	169	1.04	1.20
January	....	....	157	.969	1.12
February	....	....	135	.833	.87

BAD RIVER NEAR ODANAH, WIS.

LOCATION.—In sec. 25, T. 47 N., R. 3 W., 8 miles upstream from Odanah, Ashland County, 12 miles above mouth. Potato River enters from right about 8 miles above station.

DRAINAGE AREA.—607 square miles (measured on map issued by Wisconsin Geological & Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—July 31, 1914, to September 30, 1917.

GAGE.—Stevens continuous water-stage recorder, installed March 31, 1915, over a wooden well, just above first falls above the mouth of river. A Gurley water-stage recorder at the same site was used July 31, 1914, to March 31, 1915.

DISCHARGE MEASUREMENTS.—Made from a cable about 700 feet upstream from the gage.

CHANNEL AND CONTROL.—Bed of channel is sand and gravel. Rock outcrops at the beginning of rapids about 200 feet below the gage form a permanent control. During log-driving periods logs may collect on the outcrop and cause backwater at the gage. Right bank high and not subject to overflow; left bank of medium height and may be overflowed by extremely high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.05 feet at 9 a. m. April 21 (discharge, 4,060 second-feet); minimum discharge somewhat less than 90 second-feet, in February.

1914–1917: Maximum stage recorded, 6.66 feet at 1 a. m. April 22, 1916 (discharge, 12,200 second-feet); minimum discharge occurred in February, 1917.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—A number of small reservoirs are operated during the early spring and summer as an aid to log driving. During such periods the stage may fluctuate rapidly.

ACCURACY.—Stage-discharge relation fairly permanent except when affected by ice. Rating curve well defined between 80 and 7,270 second-feet; extended above 7,270 second-feet and may be subject to considerable error. Operation of water-stage recorder only fairly satisfactory from October 1 until ice formed; record continuous from April 16 to September 30. Daily discharge October 1 to April 15 ascertained by applying to rating table mean daily gage height obtained by planimeter from recorder graph except for the following periods: October 6–12 and October 2 to November 15, discharge was estimated from records of flow in adjoining drainage basins; December 14 to April 15 (stage-discharge relation affected by ice), discharge determined from current-meter measurements and comparison with records of flow of streams in adjacent drainage basins; discharge April 16 to September 30 obtained by discharge integrator. Open-water records good except those based on estimates, which are fair; winter records roughly approximate.

Discharge measurements of Bad River near Odanah, Wis., during the year ending Sept. 30, 1917.

[Made by R. B. Kilgore.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 10 [a]	1.58	72	Mar. 2 [a]	1.78	92
Jan. 27 [a]	1.76	90	May 11	2.28	1,270

[a] Complete ice cover.

Daily discharge, in second-feet, of Bad River near Odanah, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	354		236					2,160	1,820	680	300	250
2	311		230					2,120	1,760	540	280	230
3	258		230					2,290	1,390	460	250	210
4	241		230					2,400	1,450	460	245	195
5	264		236					1,930	1,690	410	245	195
6			219					1,840	1,490	670	230	190
7			253					1,620	1,920	1,140	200	190
8		270	258			95	400	1,570	2,420	1,050	220	190
9	250		219					1,460	1,980	890	250	190
10			183					1,340	1,590	680	275	190
11			180					1,240	1,210	580	265	190
12			175					1,120	1,030	530	245	185
13	305		160					1,050	790	540	240	190
14	400		150					980	660	410	230	190
15	435		140					890	610	390	220	250
16	435	275	135	95	90		700	860	510	380	215	300
17	435	305	130				1,040	830	470	290	205	305
18	456	275	130				1,430	840	450	280	200	305
19	470	275	125				2,010	750	620	280	200	300
20		269	120				2,900	720	1,120	255	200	270
21		247	120				3,340	680	1,100	250	200	250
22		253	115				2,800	605	880	250	200	240
23		253	110				2,170	580	770	280	195	220
24		241	105			130	1,830	490	640	650	195	210
25	260	219	100				1,710	470	650	840	240	195
26		198	100				1,500	420	910	650	285	195
27		264	95				1,420	420	980	450	295	210
28		264	95				1,690	390	840	350	305	260
29		253	95		......		1,880	380	840	290	305	280
30		241	95		......		2,010	390	730	240	290	295
31		......	95		......		......	810	......	250	270	......

NOTE.—Gage not in operation Oct. 6–12, Oct. 20 to Nov. 15. Stage-discharge relation affected by ice Dec. 12 to Apr. 15.

Monthly discharge of Bad River near Odanah, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 607 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	....	....	298	0.491	0.57
November	....	....	263	.433	.48
December	258	....	157	.259	.30
January	....	....	95	.157	.18
February	....	....	90	.148	.15
March	....	....	109	.180	.21
April	3,340	....	1,150	1.89	2.11
May	2,400	380	1,090	1.80	2.08
June	2,420	450	1,110	1.83	2.04
July	1,140	240	497	.819	.94
August	305	195	242	.399	.46
September	305	185	229	.377	.42
The year	3,340	....	444	.731	9.94

STREAMS TRIBUTARY TO LAKE MICHIGAN.

MENOMINEE RIVER BELOW KOSS, MICH.

LOCATION.—In sec. 5, T. 33 N., R. 23 E., at "Grand Rapids," about 4 miles below Koss, Marinette County, Mich., and 3 miles west of Ingalls, Mich. Little Cedar River, draining an area entirely in Michigan, enters from the left about half a mile below the station.

DRAINAGE AREA.—3,790 square miles.

RECORDS AVAILABLE.—July 1, 1913, to September 30, 1917.

DISCHARGE.—The flow is computed by the Menominee & Marinette Light & Traction Co., of Menominee, Mich., as follows: Each hour the load on the generators is noted and gage heights are read of the head and tail water to determine the head on the spillway of the dam and the acting head on the turbines. The flow through the turbines for each hour is taken from a table giving the discharge corresponding to load and head. The flow over the spillway is taken from a table computed from a weir formula. When water is wasted through the gates the magnitude and duration of the gate openings are noted and the quantity wasted is determined from computed tables. The sum of the hourly flow through the turbines and over the spillway, plus the quantity wasted through the gates, divided by the number of seconds in 24 hours, gives the average discharge in second-feet for the day. No account is taken of the water passing through the exciter turbine, nor waste over the "trash gate" at the power house. This quanity is, however, relatively small.

EXTREMES OF DISCHARGE.—Maximum daily discharge recorded during year, 13,800 second-feet April 24; minimum daily discharge recorded, 1,550 second-feet February 21.

1913–1917: Maximum daily discharge recorded, 23,200 second-feet, April 23 and 25, 1916; minimum daily discharge recorded, 1,000 second-feet, June 14, 1914.

REGULATION.—Above the station are the following power plants: Sturgeon Falls, owned by Penn. Iron Mining Co., 50 miles; Little Quinnesec, owned by Kimberly Clark Co., 57 miles; Upper Quinnesec, owned by Oliver Iron Mining Co., 62 miles; Twin Falls, owned by Peninsular Power Co. With the exception of the Kimberly Clark dam at Little Quinnesec, the dams furnish power for utility and mining uses, so that the flow past the dams is comparatively uniform. The Kimberly Clark dam is used for paper mills and regulates the flow on Sundays and holidays. The effect of this dam is felt at the stations generally on Tuesdays. The monthly flow should represent the natural flow.

ACCURACY.—No current-meter measurements have been made by the Survey engineers at this plant, but records of measurements made at Koss, Mich., during the year ending September 30, 1914, show a close comparison with the discharge as determined at the power house.

COOPERATION.—Daily discharge records furnished monthly by Edward Daniell, general manager of the Menominee & Marinette Light & Traction Co.

Daily discharge, in second-feet, of Menominee River below Koss, Mich., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	7,670	7,640	4,830	2,070	1,910	1,880	3,970	11,000	4,900	5,870	2,160	3,140
2	6.520	8,130	4,500	2,080	1,860	1,570	4,090	11,300	5,460	5,310	2,030	3,320
3	6,370	7,890	4,200	2,370	1,850	1,710	4,820	11,600	5,290	4,580	2,180	3,000
4	4,740	7,770	4,600	2,450	1,840	1,603	5,140	11,600	5,530	5,000	2,280	2,150
5	4,260	7,330	5,150	2,440	1,780	1,730	5,640	11,100	6,900	4,350	2,330	2,520
6	3,910	6,690	4,480	2,510	1,670	1,930	5,560	10,600	7,130	4,050	2,400	2,980
7	3,830	6,420	4,220	2,400	1,820	1,860	5,890	9,790	9,200	4,510	2,320	2,980
8	3,560	5,660	4,190	2,290	2,050	1,970	6,280	10,500	10,300	2,960	2,880	2,790
9	2,820	5,750	3,910	2,400	1,850	1,880	6,810	8,890	11,600	3,750	3,680	2,850
10	3,390	6,820	3,180	2,320	1,940	1,790	7,220	9,770	13,000	3,340	3,770	2,370
11	3,010	7,590	2,360	2,260	1,810	2,110	7,660	9,680	12,100	2,780	3,560	2,110
12	3,100	7,820	2,200	2,210	1,760	1,940	7,340	7,850	10,900	3,070	3,600	2,100
13	3,180	7,520	2,380	1,930	1,720	1,760	7,490	7,500	9,210	3,250	3,400	2,300
14	3,340	6,860	2,470	2,250	1,720	1,920	7,651	7,250	8,150	3,370	3,960	2,550
15	3,840	5,220	2,480	1,840	1,840	1,910	7,160	7,340	6,900	3,030	3,840	3,040
16	4,560	3,610	2,430	1,770	1,900	1,840	6,230	7,180	6,480	3,040	3,360	3,440
17	4,660	3,460	2,590	1,900	1,880	1,770	6,190	7,150	6,020	3,260	3,140	3,720
18	4,850	4.130	2,270	1,940	1,970	1,980	5,460	7,210	5,600	2,860	3,000	4,040
19	5,150	4,720	2,030	1,880	1,770	1,820	6,560	7,220	4,650	2,720	2,890	3,760
20	5,420	5,290	2,440	1,650	1,710	1,750	8,900	7,760	4,920	2,600	2,870	3,590
21	5,350	5,310	2,460	1,980	1,550	1,820	10,800	7,420	5,410	3,310	2,650	3,540
22	5,130	5,010	2,480	1,610	1,570	2,030	11,000	7,430	6,290	2,620	2,920	3,430
23	5,150	5,220	2,460	1,560	1,720	2,230	12,300	6,770	6.450	2,540	3,410	2,980
24	4,990	5,620	2,570	1,660	1,740	2,190	13,800	6,900	6,220	2,890	2,960	2,655
25	4,860	2,380	2,120	1,880	2,080	2,550	13,700	6,530	5,570	2,730	2,820	2,660
26	5,310	2,260	2,360	1,910	1,780	2,680	11,900	5,460	4,650	2,710	2,500	2,440
27	6,380	3,070	2,400	1,990	1,780	2,880	10,900	5,280	5,810	2,430	2,980	2,430
28	6,140	3,470	2,420	2,010	1,860	3,180	10,200	4,730	7,320	2,110	2,590	2.570
29	6,830	4,240	2,410	1,960	......	3,320	10,200	4,840	7,140	2,580	2,860	2,460
30	6,910	5,020	2,380	1,970	......	3,680	10,200	4,530	6,500	1,970	2,743	2,710
31	7,430	......	2,230	1,920	......	3,730	......	4,350	......	1,990	3,090	......

Monthly discharge of Menominee River below Koss, Mich., for the year ending Sept. 30, 1917.

[Drainage area, 3,790 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	7,670	2,820	4,920	1.30	1.50
November	8,130	2,260	5,600	1.48	1.65
December	5,150	2,030	3,010	.794	.92
January	2,510	1,560	2,050	.541	.62
February	2,080	1,550	1,810	.478	.50
March	3,730	1,570	2,160	.570	.66
April	13,800	3,970	8,040	2.12	2.36
May	11,600	4,350	7,960	2.10	2.42
June	13,000	4,650	7,190	1.90	2.12
July	5,870	1,970	3,290	.868	1.00
August	3,960	2,030	2,940	.776	.89
September	4,040	2,100	2,890	.763	.85
The year	13,800	1,550	4,320	1.14	15.49

NOTE.—Monthly and yearly discharge computed by engineers of the United States Geological Survey from records of daily discharge furnished by Menominee & Marinette Light & Traction Co.

PINE RIVER NEAR FLORENCE, WIS.

LOCATION.—In secs. 23 and 26, T. 39 N., R. 17 E., at highway bridge 8 miles southwest of Florence, Florence County, and 12 miles above mouth of river. Popple River enters from right about 200 feet above station.

DRAINAGE AREA.—488[a] square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—January 22, 1914, to September 30, 1917.

GAGE.—Chain gage fastened to guard rail on upstream side of bridge; read by William Taft.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge or by wading.

CHANNEL AND CONTROL.—Coarse gravel and stones. Left bank high; not subject to overflow; extremely high water may overflow right bank around approach to bridge.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.90 feet at noon, June 8 (discharge, 2,460 second-feet); minimum estimated discharge 135 second-feet in January and February.

1914–1917: Maximum recorded stage, 9.25 feet at noon, April 23, 1916 (discharge, about 4,520 second-feet); minimum recorded stage, 1.6 feet, September 6 and 7, 1915 (discharge, about 118 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—River not used for log driving during year. Gates of a dam below remained open throughout the year.

ACCURACY.—Stage-discharge relation practically permanent; rating curve fairly well defined between 200 and 418 second-feet and well defined between 418 and 1,540 second feet; extension of curve below 200 and above 1,540 second-feet may be subject to considerable error. Gage read once daily to half-tenths. Daily discharge ascertained by applying daily gage height to rating table, except for period when stage-discharge relation was affected by ice, for which it was obtained from results of current-meter measurements, observer's notes, and weather records. Open-water records good except for extreme high and low stages; winter records fair.

Discharge measurements of Pine River near Florence, Wis., during the year ending Sept. 30, 1917.

[Made by R. B. Kilgore.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Jan. 1[b]	2.90	177	Mar. 5[a]	3.22	173
30[b]	3.00	179	June 25	4.30	1,060

[a] Supersedes figure published in previous reports. Revision based on the fact that Kentuck Lake discharges into Brule River, rather than into Pine River.

[b] Complete ice cover.

Daily discharge, in second-feet, of Pine River near Florence, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	690	797	518	175	175	170	745	1,380	905	905	169	287
2	655	761	518	175	160	170	795	1,330	869	869	196	287
3	620	725	484	175	150	155	850	1,290	905	833	256	287
4	552	690	451	190	145	140	905	1,290	941	833	352	303
5	518	690	418	200	155	170	940	1,330	1,010	797	385	319
6	451	690	418	200	165	175	975	1,380	1,430	761	402	319
7	385	725	385	200	180	180	995	1,430	1,780	690	418	336
8	385	761	385	200	190	185	1,010	1,430	2,460	655	451	287
9	385	761	385	200	195	190	1,010	1,480	2,380	620	451	319
10	418	797	370	200	200	195	975	1,540	2,240	620	418	319
11	418	797	370	200	180	200	940	1,540	2,100	552	385	352
12	451	761	350	195	180	210	725	1,600	1,840	518	352	368
13	451	725	335	195	165	215	638	1,330	1,720	451	352	385
14	468	690	320	195	150	220	552	1,290	1,540	418	336	434
15	484	690	305	210	150	225	484	1,250	1,430	385	319	484
16	518	690	305	220	150	235	468	1,210	1,210	352	319	451
17	518	725	285	220	160	250	451	1,210	1,130	319	287	418
18	552	760	270	220	145	255	588	1,170	1,090	303	240	418
19	552	760	255	210	140	265	725	1,130	1,010	287	225	385
20	586	725	225	200	140	275	1,090	1,050	941	287	256	368
21	620	690	210	160	140	285	1,330	977	905	256	256	352
22	690	655	210	160	135	305	1,380	905	869	256	272	319
23	690	620	195	160	150	335	1,290	869	761	256	272	319
24	725	552	195	150	160	350	1,250	833	725	240	287	319
25	761	518	195	135	155	385	1,210	797	690	240	287	319
26	797	552	180	140	170	420	1,130	725	655	225	287	336
27	869	586	180	145	180	470	1,130	1,050	655	225	256	352
28	905	586	180	155	175	520	1,090	1,010	690	196	256	352
29	905	552	180	165	....	585	1,290	977	690	169	256	368
30	869	552	180	180	....	640	1,330	941	725	169	272	368
31	833	....	180	180	....	690	....	905	....	169	287	......

NOTE.—Stage-discharge relation affected by ice Nov. 13–21, and Dec. 10 to April 11; gage not read Apr. 13, 16, and 18; discharge interpolated.

Monthly discharge of Pine River near Florence, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 488 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	905	385	604	1.24	1.43
November	797	518	686	1.41	1.57
December	518	180	304	.623	.72
January	220	135	184	.377	.43
February	200	135	162	.332	.35
March	690	140	292	.598	.69
April	1,380	451	943	1.93	2.15
May	1,600	725	1,180	2.42	2.79
June	2,460	655	1,210	2.48	2.77
July	905	169	447	.916	1.06
August	451	169	308	.631	.73
September	484	287	350	.717	.80
The year	2,460	135	557	1.14	15.49

PIKE RIVER AT AMBERG, WIS.

LOCATION.—In sec. 15, T. 35 N., R. 21 E., at Chicago, Milwaukee & St. Paul Railway bridge half a mile south of Amberg, Marinette County, immediately below junction of two branches of Pike River, and about 11 miles above mouth.

DRAINAGE AREA.—240 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale 1 inch= 6 miles).

RECORDS AVAILABLE.—February 26, 1914, to September 30, 1917.

GAGE.—Chain gage fastened to guard rail on upstream side of bridge; read by Frank Bunce.

DISCHARGE MEASUREMENTS.—Made by wading or from a highway bridge a quarter of a mile downstream from the bridge to which the gage is attached.

CHANNEL AND CONTROL.—Solid rock and some loose granite boulders. Bed permanent but very rough at gage. Banks medium high; not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.5 feet, 8.30 a. m. June 9 (discharge 1,120 second-feet); estimated minimum discharge, 120 second-feet, during January and February.

1914–1917: Maximum stage recorded, 4.65 feet at 8.10 p. m. July 14, 1914 (discharge 1,200 second-feet); minimum stage recorded, 1.55 feet September 7, 1915 (discharge, 109 second-feet).

REGULATION.—No dams are at present in operation above this station, flow natural.

ACCURACY.—Stage-discharge relation permanent except when affected by ice. Rating curve well defined between 180 and 1,120 second-feet. Gage read to quarter-tenths, once daily. Daily discharge ascertained by applying daily gage height to rating table, except for period when stage-discharge relation was affected by ice, for which it was ascertained from current meter measurements, observer's notes, and weather records. Open-water records excellent except for extremely high stages, for which they are good. Records for winter period fair.

Discharge measurements of Pike River at Amberg, Wis., during the year ending Sept. 30, 1917.

[Made by R. B. Kilgore.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Jan. 2 [a]	2.39	180	Mar. 6 [a]	2.10	168
Jan. 31 [a]	2.36	173	June 26	2.56	371

[a] Incomplete ice cover at control.

Daily discharge, in second-feet, of Pike River at Amberg, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	620	582	273	180	150	150	476	658	364	333	192	185
2	546	546	244	180	120	145	444	698	396	318	204	169
3	476	510	273	180	120	165	546	658	428	303	192	176
4	396	460	288	170	125	185	698	620	476	288	169	169
5	364	428	273	170	125	175	658	546	582	273	180	162
6	333	396	273	160	120	165	658	493	620	258	185	177
7	333	364	288	160	125	180	658	428	862	273	176	192
8	318	364	288	160	130	195	658	396	1,080	258	288	180
9	303	396	288	170	120	210	658	380	1,120	244	318	180
10	303	428	199	170	125	230	620	364	904	230	333	176
11	288	412	244	160	135	220	582	348	778	217	288	169
12	273	380	273	160	140	210	582	333	698	217	244	158
13	318	333	230	150	140	215	582	318	546	217	364	180
14	273	244	217	140	140	220	510	318	493	217	380	244
15	303	273	215	130	145	235	460	303	428	204	380	258
16	303	303	230	130	150	250	428	303	380	204	333	258
17	318	333	215	120	165	240	380	303	333	204	318	244
18	364	333	215	120	180	230	412	318	333	204	258	230
19	348	348	215	130	160	240	476	333	333	192	244	204
20	348	318	230	130	145	245	582	348	318	217	244	192
21	364	303	215	120	145	290	582	348	318	217	258	176
22	380	303	215	120	150	340	582	318	303	204	244	158
23	364	288	230	120	150	285	582	303	303	192	237	169
24	348	303	245	130	150	230	510	303	318	180	230	162
25	396	244	260	140	155	440	476	288	303	180	204	158
26	510	303	260	140	155	645	412	288	364	180	204	162
27	546	348	260	150	150	725	460	273	380	192	204	158
28	546	318	245	150	150	610	546	258	348	180	348	158
29	510	318	230	160	....	675	582	258	318	169	348	162
30	546	273	205	170	....	698	620	244	318	158	199	156
31	582	....	180	175	....	510	....	303	....	148	180	......

NOTE.—Stage-discharge relation affected by ice Dec. 15, to Mar. 29; gage not read Aug. 23 and Sept. 6; discharge interpolated.

Monthly discharge of Pike River at Amberg, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 240 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	620	273	394	1.64	1.89
November	582	244	358	1.49	1.66
December	288	180	242	1.01	1.16
January	180	120	150	.625	.72
February	180	120	142	.592	.62
March	725	145	308	1.28	1.48
April	698	412	547	2.28	2.54
May	698	244	376	1.57	1.81
June	1,120	303	492	2.05	2.29
July	333	148	223	.925	1.07
August	380	169	256	1.07	1.23
September	258	158	184	.767	.86
The year	1,120	120	306	1.28	17.33

PESHTIGO RIVER AT HIGH FALLS, NEAR CRIVITZ, WIS.

LOCATION.—In sec. 1, T. 32 N., R. 18 E., at High Falls, near Crivitz, Marinette County, about a quarter of a mile downstream from power house of Wisconsin Public Service Co., 1 mile upstream from Thunder River (coming in from the right), and 15 miles by road northwest of Crivitz.

DRAINAGE AREA.—520[1] square miles (measured on Wisconsin Geological & Natural History Survey map, edition of 1911; scale: 1 inch=6 miles).

RECORDS AVAILABLE.—October 1, 1912, to September 30, 1917.

GAGE.—Barrett and Lawrence water-stage recorder set over a wooden well about 15 feet from the left bank and quarter of a mile downstream from power house; well is protected from floating logs by a large boulder.

DISCHARGE MEASUREMENTS.—Made from cable half a mile below gage.

CHANNEL AND CONTROL.—Banks at control and measuring section are high and not subject to overflow. Control for gage at low stages is a small gravel riffle about 50 feet downstream from the gage; apparently drowned out at medium and high stages, when control is probably formed by some point farther downstream.

EXTREMES OF DISCHARGE.—Maximum mean daily discharge during the year, 2,590 second-feet; minimum mean discharge, 104 second-feet January 7.

1912–1917: Maximum stage, from water-stage recorder, 7.2 feet, May 13, 1916 (discharge, 3,480 second-feet); minimum stage, 1.1 feet at 5 p. m. March 21, 1915 (discharge, 54 second-feet). Owing to artificial regulation extremes given do not represent the natural flow.

ICE.—Because of the relatively warm water in the large service reservoir ice does not form on the river in the vicinity of the gage; open-water rating curve used throughout year.

REGULATION.—Flow controlled by operation of the power plant. During log-driving seasons large and sudden fluctuations are caused by the operation of logging and sluice gates. The fluctuation due to changes in load are relatively small. The mean monthly flow does not represent the natural flow because of storage in the service reservoir.

ACCURACY.—Stage-discharge relation permanent; not affected by ice. Rating curve well defined between 145 and 3,980 second-feet. During periods when recording gage was in operation discharge ascertained by averaging the results obtained by applying gage heights for hourly or other regular intervals to the rating table; for period when gage was not in operation (see footnote to table of daily discharge) discharge determined from power-plant records. From the data available the power-plant records are believed to be accurate within 5 per cent.

The following discharge measurement was made by R. B. Kilgore:

June 23, 1917: Gage height, 3.37 feet; discharge, 1,150 second-feet.

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[1] Supersedes figure published in previous reports.

Daily discharge, in second-feet, of Peshtigo River at High Falls, near Crivitz, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,020	1,050	632	274	318	579	349	1,220	956	641	614	555
2	1,050	1,040	632	377	273	596	505	1,230	782	784	590	357
3	983	1,030	433	343	287	484	575	1,180	542	721	577	296
4	835	1,040	641	303	120	279	607	1,200	881	531	580	517
5	699	850	638	256	303	413	615	1,210	994	600	339	562
6	690	962	606	256	397	485	574	961	1,280	587	551	621
7	567	893	600	104	384	499	593	1,240	1,860	587	642	605
8	410	805	614	238	390	501	326	1,250	2,180	391	649	667
9	538	653	606	268	382	551	499	1,170	2,590	547	622	361
10	613	681	378	276	358	500	561	1,050	2,540	627	655	548
11	544	983	471	247	204	306	543	1,390	2,370	619	635	579
12	577	820	513	267	321	435	750	1,200	1,940	618	360	580
13	581	962	534	279	360	524	1,130	703	1,600	592	563	620
14	578	910	493	111	360	541	803	549	1,310	554	633	604
15	409	632	470	238	360	558	577	652	1,200	334	615	575
16	527	647	475	265	359	489	725	779	1,230	506	609	304
17	579	630	278	274	368	432	808	563	900	591	586	498
18	640	660	423	275	186	254	712	563	992	569	544	481
19	674	537	492	275	285	469	764	616	740	545	290	509
20	759	881	485	269	368	549	775	674	764	556	523	462
21	729	628	460	138	405	564	747	944	947	523	623	484
22	633	679	468	246	463	587	841	905	946	322	585	467
23	728	653	458	270	496	542	1,430	760	957	493	557	226
24	644	632	276	275	476	563	1,400	611	756	537	554	293
25	734	636	226	276	303	304	1,260	576	768	543	561	395
26	818	425	429	258	430	486	1,210	558	763	578	300	355
27	860	569	465	260	480	563	1,040	376	723	573	529	360
28	920	630	451	112	542	564	1,140	768	728	570	587	388
29	1,080	630	457	224	....	539	1,140	691	785	351	563	431
30	1,220	465	462	256	....	533	1,430	406	822	366	567	174
31	1,010	....	274	296	....	540	....	877	....	609	545	....

NOTE.—Discharge based on power-plant records as follows: Oct. 18, 20, 25, 26, 31; Nov. 1, 5–9, 12–30; Dec. 1–31; Jan. 1–9, 11–18, 25–28; Feb. 2–7; Apr. 8–12, 25–28; May 3, 6–9, 13–17, 24, 29–31; June 5–12, 14–30; July 1–31; Aug. 1–31; Sept. 1–6, 9–10, 16–20, 23–27, 30. About 2 second-feet of seepage water enters the river below the gage but above the cable and is included in the published record.

Monthly discharge of Peshtigo River near Crivitz, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 520 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,220	409	731	1.41	1.63
November	1,050	425	754	1.45	1.62
December	641	226	479	.921	1.06
January	377	104	252	.485	.56
February	542	120	356	.685	.71
March	596	254	491	.944	1.09
April	1,430	326	814	1.57	1.75
May	1,390	376	867	1.67	1.92
June	2,590	542	1,190	2.29	2.56
July	784	322	547	1.05	1.21
August	655	290	553	1.06	1.22
September	667	174	466	.896	1.00
The year	2,590	104	626	1.20	16.33

OCONTO RIVER NEAR GILLETT, WIS.

LOCATION.—In sec. 34, T. 28 N., R. 18 E., at highway bridge 2½ miles southeast of Gillett, Oconto County, and about 27 miles above mouth of river.

DRAINAGE AREA.—678 square miles (measured on Wisconsin Geological and Natural History Survey Map, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—June 7, 1906, to March 30, 1909; January 6, 1914, to September 30, 1917.

GAGE.—Chain gage attached to iron railing on upstream side of bridge; read by Miss Nettie Gilbertson. Zero of gage used January 6, 1914, to September 30, 1917, is 4 feet above that of gage used June 7, 1906, to March 31, 1909.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge.

CHANNEL AND CONTROL.—Gravel; fairly permanent; left bank medium high and not subject to overflow; right bank may overflow during extreme flood stages and water flow around the end of the bridge.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.7 feet, at 3.30 p. m. April 2 (discharge estimated, because of ice, 2,870 second-feet); estimated minimum discharge, 305 second-feet, January 24 to February 1.

1906–1917: Maximum stage recorded, 5.3 feet at 3.30 p. m. April 25, 1916 (discharge 3,220 second-feet); minimum open-water discharge, 95 second-feet January 3 and 6, 1907.

ICE.—Stage-discharge relation affected by ice.

REGULATION.—A dam above the station stores water to float logs during the spring; except when this dam is in operation flow at the gage is natural.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve well defined between 239 and 1,790 second-feet. Gage read to quarter-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table, except for period when stage-discharge relation was affected by ice, for which it was obtained by applying to rating curve mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good, except for extreme flood stages, for which they are only fair; winter records fair.

Discharge measurements of Oconto River near Gillett, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 6[a]	H. C. Beckman	2.78	421	Mar. 8[a]	E. L. Williams	2.93	373
Feb. 6[a]	E. L. Williams	2.79	358	June 21	R. B. Kilgore	2.02	770

[a] Complete ice cover.

Daily discharge, in second-feet, of Oconto River near Gillett, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	930	1,290	870	470	305	335	2,790	1,570	670	1,430	362	[illegible]
2	930	1,290	780	470	325	330	2,870	1,570	780	2,630	362	[illegible]
3	900	1,290	725	445	325	330	2,090	1,570	840	1,290	424	[illegible]
4	900	1,290	725	445	340	325	2,320	1,570	1,020	960	424	[illegible]
5	752	1,220	725	425	340	320	2,090	1,500	1,020	960	424	[illegible]
6	752	1,220	780	425	360	325	1,790	1,430	1,220	698	424	[illegible]
7	725	1,160	840	405	360	330	1,790	1,160	1,430	565	424	[illegible]
8	725	1,160	780	405	360	365	1,570	1,290	1,860	670	468	[illegible]
9	615	1,160	725	380	360	405	1,500	1,160	2,160	670	1,160	[illegible]
10	615	1,160	698	380	360	405	1,430	1,090	2,160	615	615	[illegible]
11	615	1,160	492	380	360	405	1,430	1,020	2,320	590	565	[illegible]
12	698	[illegible]	468	360	360	405	1,430	960	2,160	565	615	[illegible]
13	670	1,160	468	360	360	405	1,430	930	1,790	565	615	[illegible]
14	642	1,160	425	360	350	415	1,430	870	1,790	565	670	[illegible]
15	642	960	425	360	340	425	1,430	870	1,360	515	670	[illegible]
16	725	780	380	340	340	435	1,290	840	1,290	515	780	615
17	615	[illegible]	380	340	340	445	1,290	780	1,640	515	780	615
18	590	900	380	340	340	455	1,220	725	1,290	540	[illegible]	615
19	590	1,020	380	340	340	460	1,290	752	992	515	670	565
20	725	960	405	340	340	465	1,290	780	840	492	698	565
21	752	900	425	325	340	470	1,360	810	780	468	670	515
22	752	752	470	325	340	505	1,360	840	780	424	515	515
23	725	840	515	325	340	540	1,220	810	780	446	515	492
24	725	840	565	305	340	735	1,220	810	810	424	515	492
25	780	900	565	305	340	930	1,220	752	615	424	468	468
26	960	900	565	305	360	1,160	1,290	752	752	424	468	468
27	960	565	540	305	380	1,430	1,430	670	698	403	468	468
28	1,020	670	515	305	365	1,790	1,500	670	725	382	424	446
29	1,360	810	515	305	....	2,090	1,570	670	780	382	382	468
30	1,090	840	490	305	....	2,390	1,570	670	1,500	382	565	424
31	1,160	....	470	305	....	2,630	....	670	....	362	515	....

NOTE.—Stage-discharge relation affected by ice Dec. 14 to Apr. 3.

Monthly discharge of Oconto River near Gillett, Wis., for the year ending Sept. 30, 1917.

[Drainage area 678 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,360	590	795	1.17	1.35
November	1,290	565	1,010	1.49	1.66
December	870	380	564	.832	.96
January	470	305	361	.532	.61
February	380	305	347	.512	.53
March	2,630	320	724	1.07	1.23
April	2,870	1,220	1,580	2.33	2.60
May	1,570	670	986	1.45	1.67
June	2,320	615	1,230	1.81	2.02
July	2,630	362	658	.971	1.12
August	1,160	362	561	.827	.95
September	615	424	516	.761	.85
The year	2,870	305	778	1.15	15.55

FOX RIVER AT RAPIDE CROCHE DAM, NEAR WRIGHTSTOWN, WIS.

LOCATION.—At Rapide Croche dam, in sec. 4, T. 21 N., R. 19 E., 2 miles upstream from Wrightstown, Brown County, 19 miles downstream from Lake Winnebago, and 20 miles upstream from mouth of river at Green Bay.

RECORDS AVAILABLE.—March 3, 1896, to September 30, 1917. Daily-discharge records for this station, 1896–1914, were published by the Wisconsin Railroad Commission in a report entitled "Water-power report to the Legislature, 1915." The records published in this report have since been found to be considerably in error and should not be used. See "Determination of flow."

DRAINAGE AREA.—6,150 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

DETERMINATION OF DISCHARGE.—The dam is owned and operated by the United States Army Engineers to aid navigation, and the flow is computed by the United States Army Engineers as follows: The dam is made of timber and is equipped with 4 needle sluice gates which are used only in times of high water. A vertical staff gage at the lower end of the canal leading to the lock and about a quarter of a mile below the dam is read five times daily at 7 a. m., 9 a. m., 12 noon, 3 p. m., and 6 p. m. The mean flow for the day is computed from a formula using the 5 gage heights for the day, assuming gradual changes in gage height between the readings, and weighting the different gage heights by elapsed time. Prior to 1917 determinations of daily discharge were based on tables derived from theoretical formulas for flow over a sharp-crested weir and through the sluice gates. During 1917 discharge measurements were made by engineers of the United States Geological Survey from a cable a short distance downstream from the dam. Seven measurements were made with the four sluices closed and eight with all sluices open. The measured discharge varied from 1,000 to 13,000 second-feet. Curves based on the discharge measurements show that the theoretical formulas gave results ranging from about 850 second-feet too small at low stages, with the sluices closed, to 250 second-feet too large at high stages, with all sluices open. The deficiency of amounts in the old records as published is due to the fact no allowance was made for leakage through the dam, which is now determined to be about 1,000 second-feet with water at the crest of the dam and all gates closed. Discharge measurements made by the United States Geological Survey in 1902 and 1903 at Wrightstown, about 2 miles below the dam, indicate that the leakage at the dam was apparently the same during 1902 and 1903 as at the present time. As Rapide Croche dam was built in 1878 and existed in 1902 as in 1917, it is considered necessary and proper to correct the old records for 1896–1917 to agree with the results of the current-meter measurements of 1917. The records published herewith are the old records corrected by means of the curves for 1917, each recomputation taking into consideration the relation between the old and new curves according to the number of sluice gates open. Corrections were applied to the semimonthly and monthly mean discharge. The yearly discharge is derived from the mean monthly discharge. The semimonthly and mean monthly discharge was computed by engineers of the office of the Army Engineer Corps at Milwaukee; the flow in second-feet per square mile, run-off depth in inches, and yearly means and totals were computed by engineers of the United States Geological Survey.

EXTREMES OF DISCHARGE.—Not determined. Information regarding the daily maximum and minimum may be obtained from the office of the Corps of Engineers, United States Army, Milwaukee, Wis.

REGULATION.—Flow regulated by Lake Winnebago, which has an area of 215 square miles, and also by dams between the outlet of Lake Winnebago and the station, the dams being operated for power development and to some extent in the interests of navigation. Under existing conditions, which, as regards storage, have been the same throughout the period covered by the records, the flow past the station is natural.

ACCURACY.—Though the accuracy of the records prior to 1902–1903 is somewhat doubtful it is believed that the records for entire period are good. See "Determination of discharge."

COOPERATION.—Records collected and monthly and semimonthly discharge computed by the United States Army Engineers from curves based on current-meter measurements made by engineers of the United States Geological Survey.

Discharge of Fox River at Rapide Croche dam, Wis., for years ending Sept. 30, 1896–1917.

[Drainage area, 6,150 square miles.]

Month.	Mean discharge, in second-feet.				Run-off (depth in inches on drainage area).
	Semimonthly.		Monthly.		
	First half.[a]	Second half.[b]	Mean.	Per square mile.	
1896.					
March	1,980	2,010	1,990	0.324	0.37
April	1,520	1,700	1,610	.262	.29
May	3,440	4,130	3,800	.618	.71
June	4,530	4,170	4,350	.707	.79
July	3,710	3,280	3,490	.567	.65
August	2,680	1,720	2,180	.354	.41
September	1,020	970	990	.161	.18
The period					
1896–97.					
October	1,600	2,020	1,820	.296	.34
November	2,510	2,950	2,730	.444	.50
December	3,330	2,790	3,080	.501	.58
January	3,400	3,500	3,450	.561	.65
February	3,360	3,590	3,470	.564	.59
March	3,050	3,740	3,410	.554	.64
April	5,910	7,300	6,600	1.07	1.19
May	4,900	4,350	4,620	.751	.87
June	3,830	3,990	3,910	.636	.71
July	3,920	3,800	3,860	.628	.72
August	3,210	1,980	2,570	.418	.48
September	1,330	1,830	1,580	.257	.29
The year			3,420	.556	7.56
1897–98.					
October	1,840	2,440	2,150	.350	.40
November	2,300	2,540	2,420	.393	.44
December	2,870	3,110	2,990	.486	.56
January	3,380	3,280	3,330	.541	.62
February	3,220	2,940	3,090	.502	.52
March	3,460	3,830	3,650	.593	.68
April	3,990	4,950	4,470	.727	.81
May	5,640	4,730	5,170	.841	.97
June	4,500	3,270	3,880	.631	.70
July	2,380	2,210	2,290	.372	.43
August	2,190	2,880	2,550	.415	.48
September	2,110	1,560	1,830	.298	.33
The year			3,150	.512	6.94
1898–99.					
October	1,590	2,270	1,940	.315	.36
November	2,870	3,010	2,940	.478	.53
December	3,060	2,760	2,910	.473	.55
January	2,770	2,490	2,630	.428	.49
February	2,950	2,630	2,800	.455	.47
March	2,640	3,280	2,970	.483	.56
April	4,150	4,420	4,280	.696	.78
May	6,310	6,690	6,510	1.06	1.22
June	5,570	7,350	6,460	1.05	1.17
July	4,710	3,930	4,310	.701	.81
August	2,990	2,170	2,570	.418	.48
September	1,740	1,720	1,730	.281	.31
The year			3,500	.569	7.73

[a] 15 days. [b] Sixteenth to end of month.

Discharge of Fox River at Rapide Croche dam, Wis., for years ending Sept. 30, 1896–1917—Continued.

Month.	Mean discharge, in second-feet.				Run-off (depth in inches on drainage area).
	Semimonthly.		Monthly.		
	First half.	Second half.	Mean.	Per square mile.	
1899-1900.					
October	1,740	2,010	1,880	0.306	0.35
November	2,950	2,750	2,850	.463	.52
December	2,870	2,660	2,760	.449	.52
January	2,860	2,950	2,910	.473	.55
February	2,920	3,040	2,980	.485	.50
March	2,990	3,530	3,270	.532	.61
April	3,950	4,170	4,060	.660	.74
May	3,560	3,750	3,660	.595	.69
June	2,070	1,220	1,640	.267	.30
July	1,200	2,210	1,730	.281	.32
August	2,580	2,520	2,550	.415	.48
September	2,600	2,880	2,740	.446	.50
The year	....	....	2,750	.447	6.08
1900-1.					
October	4,830	6,610	5,750	.935	1.08
November	8,250	6,980	7,610	1.24	1.38
December	4,920	3,790	4,340	.706	.81
January	4,010	3,720	3,800	.628	.72
February	3,970	4,130	4,040	.657	.68
March	3,910	4,340	4,130	.672	.77
April	7,830	9,140	8,480	1.38	1.54
May	5,170	4,650	4,900	.797	.92
June	4,410	3,940	4,170	.678	.76
July	4,100	4,190	4,150	.675	.78
August	3,310	2,510	2,900	.472	.54
September	2,020	1,890	1,950	.317	.35
The year	....	....	4,690	.763	10.33
1901-2.					
October	2,620	3,840	3,250	.528	.61
November	3,940	3,880	3,910	.636	.71
December	3,670	3,280	3,470	.564	.65
January	3,140	2,850	2,990	.486	.56
February	2,880	2,870	2,870	.467	.49
March	3,260	3,630	3,450	.561	.65
April	3,200	2,650	2,920	.475	.53
May	3,730	6,880	5,350	.870	1.00
June	8,030	4,880	6,450	1.05	1.17
July	4,320	3,680	3,990	.649	.75
August	3,670	2,860	3,250	.528	.61
September	2,150	1,850	2,000	.325	.36
The year	....	....	3,660	.595	8.09
1902-3.					
October	2,150	2,980	2,580	.420	.48
November	3,170	3,070	3,120	.507	.57
December	3,110	2,910	3,010	.489	.56
January	3,180	3,720	3,460	.563	.65
February	3,560	3,720	3,630	.590	.61
March	3,810	4,960	4,410	.717	.83
April	7,820	5,750	6,780	1.10	1.23
May	5,540	5,730	5,640	.917	1.06
June	5,510	5,040	5,270	.857	.96
July	4,280	4,550	4,400	.715	.82
August	4,040	3,800	3,920	.637	.73
September	4,490	5,150	4,820	.784	.87
The year	....	....	4,250	.691	9.37

Discharge of Fox River at Rapide Croche dam, Wis., for years ending Sept. 30, 1896–1917—Continued.

Month.	Mean discharge, in second-feet.				Run-off (depth in inches on drainage area).
	Semimonthly.		Monthly.		
	First half.	Second half.	Mean.	Per square mile.	
1903–4.					
October	5,170	5,140	5,150	0.837	0.96
November	4,490	3,970	4,230	.688	.77
December	3,450	3,420	3,430	.558	.64
January	3,710	3,540	3,620	.589	.68
February	3,560	3,790	3,670	.597	.64
March	3,570	4,200	3,890	.633	.73
April	4,940	8,720	6,830	1.11	1.24
May	7,700	9,630	8,700	1.41	1.63
June	8,590	5,060	6,820	1.11	1.24
July	3,510	3,440	3,470	.564	.65
August	3,480	2,880	3,170	.515	.59
September	2,560	2,400	2,480	.403	.45
The year	....	....	4,620	.751	10.22
1904–5.					
October	3,670	4,400	4,050	.659	.76
November	4,180	3,780	3,980	.647	.72
December	3,750	3,600	3,670	.597	.69
January	3,810	4,120	3,970	.646	.74
February	4,480	4,150	4,330	.704	.73
March	3,820	4,250	4,040	.657	.76
April	7,770	8,810	8,290	1.35	1.51
May	5,380	5,630	5,510	.896	1.03
June	11,670	12,820	12,250	1.99	2.22
July	9,290	5,690	7,430	1.21	1.40
August	4,450	4,400	4,420	.719	.83
September	4,150	3,910	4,030	.655	.73
The year	....	....	5,500	.894	12.12
1905–6.					
October	3,380	3,550	3,470	.564	.65
November	3,690	3,610	3,650	.593	.66
December	3,580	3,450	3,510	.571	.66
January	3,650	3,940	3,800	.618	.71
February	3,890	4,050	3,960	.644	.67
March	3,980	5,200	4,610	.750	.86
April	11,690	13,910	12,800	2.08	2.32
May	10,950	5,080	7,920	1.29	1.49
June	4,430	4,680	4,550	.740	.83
July	4,500	4,310	4,400	.715	.82
August	3,200	2,990	3,090	.502	.58
September	2,850	2,780	2,810	.457	.51
The year	....	....	4,880	.793	10.76
1906–7.					
October	3,100	2,910	3,010	.489	.56
November	3,790	4,470	4,130	.672	.75
December	5,450	5,670	5,560	.904	1.04
January	5,790	5,620	5,700	.927	1.07
February	7,030	4,530	5,870	.954	.99
March	3,790	4,360	4,060	.663	.76
April	9,000	10,780	9,890	1.61	1.80
May	8,360	6,460	7,380	1.20	1.38
June	6,420	4,830	5,620	.914	1.02
July	4,310	5,390	4,870	.792	.91
August	4,200	3,770	3,980	.647	.75
September	2,900	3,460	3,180	.517	.58
The year	....	....	5,270	.857	11.61

Discharge of Fox River at Rapide Croche dam, Wis., for years ending Sept. 30, 1896–1917—Continued.

Month.	Mean discharge, in second-feet.				Run-off (depth in inches on drainage area).
	Semimonthly.		Monthly.		
	First half.	Second half.	Mean.	Per square mile.	
1907-8.					
October	3,640	3,510	3,570	0.580	0.67
November	2,570	2,780	2,670	.434	.48
December	2,940	3,090	3,020	.491	.57
January	3,180	3,360	3,270	.532	.61
February	3,440	3,440	3,440	.559	.60
March	3,760	6,470	5,160	.839	.97
April	9,220	7,020	8,120	1.32	1.47
May	8,910	10,630	9,800	1.59	1.83
June	6,140	4,020	5,080	.826	.92
July	3,390	3,590	3,500	.569	.66
August	2,840	1,890	2,350	.382	.44
September	1,590	1,380	1,480	.241	.27
The year			4,290	.698	9.49
1908-9.					
October	1,280	1,290	1,280	.208	.24
November	1,720	2,190	1,950	.317	.35
December	3,220	2,770	2,990	.486	.56
January	3,210	3,490	3,350	.545	.63
February	3,390	3,460	3,420	.556	.58
March	3,520	3,720	3,620	.589	.68
April	4,040	5,380	4,710	.766	.85
May	10,630	8,240	9,400	1.53	1.76
June	6,010	5,700	5,860	.953	1.06
July	3,960	3,080	3,510	.571	.66
August	1,580	1,660	1,620	.263	.30
September	2,280	2,180	2,230	.363	.40
The year			3,660	.595	8.07
1909-10.					
October	2,250	1,670	1,950	.317	.37
November	1,690	2,780	2,230	.363	.40
December	3,710	3,520	3,610	.587	.68
January	3,840	3,750	3,790	.616	.71
February	3,820	3,730	3,780	.615	.64
March	3,900	3,740	3,820	.621	.72
April	3,770	4,100	3,930	.639	.71
May	4,810	4,650	4,730	.769	.89
June	3,930	3,210	3,570	.580	.65
July	1,660	1,190	1,420	.231	.27
August	1,170	1,090	1,130	.184	.21
September	1,830	2,510	2,170	.353	.39
The year			3,010	.489	6.63
1910-11.					
October	2,520	2,560	2,540	.413	.48
November	2,140	2,630	2,380	.387	.43
December	3,390	3,400	3,390	.551	.64
January	3,570	3,460	3,510	.571	.66
February	3,420	4,000	3,690	.600	.62
March	3,890	3,810	3,850	.626	.72
April	4,280	3,860	4,070	.662	.74
May	3,460	3,870	3,670	.597	.69
June	7,010	4,630	5,820	.946	1.06
July	2,820	1,340	2,060	.335	.39
August	960	1,500	1,240	.202	.23
September	1,420	2,300	1,860	.302	.34
The year			3,170	.515	7.00

Discharge of Fox River at Rapide Croche dam, Wis., for years ending Sept. 30, 1896–1917—Continued.

Month.	Mean discharge, in second-feet.				Run-off (depth in inches on drainage area).
	Semimonthly.		Monthly.		
	First half.	Second half.	Mean.	Per square mile.	
1911–12.					
October	6,420	9,630	8,080	1.31	1.51
November	5,480	4,950	5,210	.847	.94
December	6,410	8,960	7,730	1.26	1.45
January	4,650	5,000	4,830	.785	.90
February	4,810	4,770	4,790	.779	.84
March	4,630	3,900	4,250	.691	.80
April	3,770	5,920	4,840	.787	.88
May	5,720	8,170	6,980	1.13	1.30
June	8,500	3,790	6,140	.998	1.11
July	2,570	3,680	3,140	.511	.59
August	8,380	6,960	7,650	1.24	1.43
September	9,550	9,050	9,300	1.51	1.68
The year			6,080	.989	13.43
1912–13.					
October	5,980	4,070	4,990	.811	.94
November	3,960	4,340	4,150	.675	.75
December	4,620	3,710	4,150	.675	.78
January	3,870	3,640	3,750	.610	.70
February	3,410	3,280	3,350	.545	.57
March	3,720	8,350	6,110	.993	1.14
April	13,650	12,150	12,900	2.10	2.34
May	7,840	9,160	8,520	1.39	1.60
June	8,860	4,240	6,550	1.07	1.19
July	3,670	4,100	3,890	.633	.73
August	3,770	3,260	3,510	.571	.66
September	2,430	2,350	2,390	.389	.43
The year			5,360	.872	11.83
1913–14.					
October	3,480	3,730	3,610	.587	.68
November	3,770	3,870	3,820	.621	.69
December	4,220	4,050	4,130	.672	.77
January	3,720	4,010	3,870	.629	.73
February	4,100	4,190	4,140	.673	.70
March	3,590	3,530	3,560	.579	.67
April	2,390	3,460	2,920	.475	.53
May	4,020	5,000	4,530	.737	.85
June	10,900	11,180	11,040	1.80	2.01
July	5,620	3,430	4,490	.730	.84
August	2,350	1,650	1,990	.324	.37
September	1,770	2,850	2,310	.376	.42
The year			4,200	.683	9.26
1914–15.					
October	2,960	2,830	2,890	.470	.54
November	2,580	2,590	2,580	.420	.47
December	2,760	2,810	2,790	.454	.52
January	2,790	3,470	3,140	.511	.59
February	4,100	4,290	4,190	.681	.71
March	7,570	7,250	7,400	1.20	1.38
April	7,130	3,610	5,370	.873	.97
May	3,330	3,560	3,450	.561	.66
June	3,660	3,620	3,640	.592	.66
July	3,330	2,930	3,120	.507	.58
August	2,790	2,310	2,540	.413	.48
September	2,200	4,700	3,450	.561	.63
The year			3,710	.603	8.19

Discharge of Fox River at Rapide Croche dam, Wis., for years ending Sept. 30, 1896–1917—Continued.

Month.	Mean discharge, in second-feet.				Run-off (depth in inches on drainage area).
	Semimonthly.		Monthly.		
	First half.	Second half.	Mean.	Per square mile.	
1915–16.					
October	5,180	4,930	5,050	0.821	0.95
November	4,560	5,180	4,870	.792	.88
December	5,610	5,050	5,320	.865	1.00
January	4,740	4,750	4,740	.771	.89
February	5,300	5,020	5,170	.841	.91
March	4,800	6,020	5,430	.883	1.02
April	12,960	11,330	13,140	2.14	2.39
May	12,720	11,320	12,000	1.95	2.25
June	9,180	11,880	10,530	1.71	1.91
July	6,120	3,890	4,970	.808	.93
August	3,100	3,370	3,240	.527	.61
September	2,840	2,970	2,900	.472	.53
The year			6,450	1.05	14.27
1916–17.					
October	3,340	4,300	3,830	.623	.72
November	5,310	6,550	5,930	.964	1.08
December	6,570	5,600	6,070	.987	1.14
January	5,920	6,480	6,210	1.01	1.16
February	4,980	4,540	4,780	.777	.81
March	4,670	5,770	5,240	.852	.98
April	12,050	12,290	12,170	1.98	2.21
May	9,920	5,300	7,540	1.23	1.42
June	5,940	8,400	7,170	1.17	1.30
July	4,900	4,300	4,590	.746	.86
August	3,740	3,910	3,830	.623	.72
September	2,810	2,650	2,730	.444	.50
The year			5,840	.950	12.90

NOTE.—Records in the above table supersede those contained in the "Water-power report to the Legislature, 1915," published by the Wisconsin Railroad Commission.

WOLF RIVER AT KESHENA, WIS.

LOCATION.—In sec. 26, T. 28 N., R. 15 E., at the highway bridge at Keshena, Shawano County, 3 miles below the junction with West Branch of Wolf River, which enters from the right.

DRAINAGE AREA.—797 square miles.

RECORDS AVAILABLE.—May 9, 1907, to March 31, 1909; February 10, 1911, to September 30, 1917.

GAGE.—Chain gage fastened to downstream side of new bridge on December 9, 1914; May 9, 1907, to November 29, 1914, vertical staff gage fastened to downstream abutment, both gages at same datum; read by Jerome M. Beauprey.

DISCHARGE MEASUREMENTS.—Made from the bridge.

CHANNEL AND CONTROL.—Gravel; smooth and practically permanent. Banks of mediun height; overflow improbable. During the last part of November and the first part of December, 1914, a new bridge was erected at the site of the old gage. The plotting of the discharge measurements made since the bridge was built indicates that the construction of the new piers changed condition of channel.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.50 feet at 5 p. m. June 8 and 8 a. m. June 9 (discharge, 2,260 second-feet); minimum discharge about 470 second-feet February 18.

1907–1909 and 1911–1917: Maximum discharge recorded 3,910 second-feet September 2, 1912; minimum open-water discharge, 275 second-feet September 26, 1908.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—The river and its main tributaries above Keshena are controlled to some extent by logging dams.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 510 and 2,260 second-feet; above and below these limits curve is extended and is subject to error. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean of daily gage heights to rating table, except for period when stage-discharge relation was affected by ice, for which it was ascertained by applying to rating curve mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records excellent except for extremely high and low stages, for which they are fair; winter records fair.

Discharge measurements of Wolf River at Keshena, Wis., during the year ending September 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 15[a]	E. L. Williams	3.49	518	Mar. 8[a]	E. L. Williams	3.28	497
Feb. 6[a]	.....do	3.36	539	June 22	R. B. Kilgore	2.61	1,070

a Ice at control.

Daily discharge, in second-feet, of Wolf River at Keshena, Wis., for the year ending September 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,130	1,190	1,020	565	540	510	1,220	1,700	810	960	670	586
2	1,020	1,250	1,130	560	545	510	1,280	1,640	909	1,020	715	586
3	960	1,130	1,130	555	535	485	1,250	1,640	909	1,020	715	547
4	909	1,130	1,020	550	560	495	1,190	1,640	1,020	960	670	586
5	859	1,190	810	545	530	490	1,190	1,640	1,250	859	627	627
6	810	1,070	715	545	540	480	1,190	1,500	1,310	715	586	715
7	810	1,020	810	540	555	495	1,190	1,190	2,120	715	762	762
8	810	1,020	715	540	540	495	1,220	1,250	2,260	670	859	715
9	762	1,020	715	535	545	485	1,220	1,190	2,190	762	960	715
10	762	1,070	670	535	520	500	1,250	1,190	1,980	909	960	670
11	762	1,070	625	530	510	495	1,310	1,250	1,910	859	909	627
12	670	1,070	620	530	515	490	1,380	1,190	1,770	859	715	547
13	715	1,020	620	525	485	490	1,310	1,250	1,500	810	909	547
14	810	810	615	525	475	490	1,250	1,190	1,440	810	1,310	547
15	810	715	615	520	375	490	1,130	1,070	1,380	627	1,070	547
16	859	670	610	520	485	520	960	1,070	1,380	547	859	627
17	715	670	605	490	510	545	859	1,020	1,130	547	762	715
18	670	760	600	495	470	515	1,130	859	1,020	627	715	715
19	762	810	600	480	475	525	1,440	810	960	586	715	715
20	909	860	595	485	490	565	1,570	960	960	547	715	670
21	909	860	595	510	485	625	1,640	960	909	547	715	475
22	960	860	590	490	490	715	1,640	909	1,020	586	670	510
23	909	810	585	495	505	785	1,570	909	1,070	586	627	510
24	859	760	580	505	500	875	1,440	909	1,070	586	627	510
25	960	715	580	505	490	960	1,440	859	1,310	547	627	547
26	1,020	715	575	490	510	960	1,380	859	1,380	586	627	475
27	1,250	810	575	480	510	990	1,440	762	1,190	627	627	475
28	1,190	1,070	570	485	510	990	1,440	715	1,020	586	627	475
29	1,130	1,190	570	505	....	1,070	1,500	715	960	586	627	510
30	1,190	1,130	565	535	....	1,100	1,700	762	909	586	627	475
31	1,190	....	565	535	....	1,160	....	810	....	586	586	......

NOTE.—Stage-discharge relation affected by ice Nov. 15 to Apr. 9.

Monthly discharge of Wolf River at Keshena, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 797 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,250	670	906	1.14	1.31
November	1,250	670	949	1.19	1.33
December	1,130	565	684	.858	.99
January	565	480	520	.652	.75
February	560	470	511	.641	.67
March	1,160	480	655	.822	.95
April	1,700	859	1,320	1.66	1.85
May	1,700	715	1,110	1.39	1.60
June	2,260	810	1,300	1.63	1.82
July	1,020	547	704	.883	1.02
August	1,310	586	748	.939	1.08
September	762	475	591	.742	.83
The year	2,260	470	834	1.05	14.20

WOLF RIVER AT NEW LONDON, WIS.

Location.—In sec. 12, T. 22 N., R. 14 E., at Pearl Street highway bridge, New London Waupaca County. Embarrass River enters from the right three-fourths of a mile above the station, and Little Wolf River, also from the right, 5 miles below.

Drainage area.—2,240 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch = 6 miles).

Records available.—Gage heights March 1, 1899, to September 30, 1917; daily discharge record, October 1, 1913, to September 30, 1917.

Gage.—Enameled steel gage, reading from 1.0 to 13.0 feet, fastened to right-hand downstream pier of Pearl Street bridge. Datum of the gage raised 0.641 foot March 1, 1911, according to the United States Army Engineers. Zero of gage 748.874 feet above mean sea level, New York City datum.

Discharge measurements.—Made from the Shawano Street bridge, two blocks below the gage.

Channel and control.—Bed composed of sand, hardpan, and mud; not permanent. No well-defined control. Banks at gage fairly high and not subject to overflow. It is reported that during extremely high stages water from Embarrass River flows across New London into the channel of Wolf River below the gage.

Extremes of discharge.—Maximum stage recorded during the year, 9.45 feet April 1 (discharge, 8,060 second-feet); minimum discharge about 840 second-feet February 8–12.

1914–1917: Maximum discharge recorded, 8,960 second-feet April 4, 1916; minimum discharge, 755 second-feet January 1–10, 1915. The United States Army Engineer Office reports a stage of 11.6 feet April 16, 1888.

Ice.—Stage-discharge relation affected by ice.

Regulation.—Little if any diurnal fluctuation due to operation of the power plants on river above station observable at gage; monthly flow natural.

Accuracy.—Stage-discharge relation not permanent. Two rating curves used during 1917; one applicable October 1 to March 31 fairly well defined between 910 and 9,280 second-feet; the other, applicable April 1 to September 30, fairly well defined between 1,080 and 9,280 second-feet. Gage read to tenths once daily. Daily discharge ascertained by applying daily gage height to rating table, except for period when stage-discharge relation was affected by ice, for which it was obtained by applying to rating table daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Records fair.

Discharge measurements of Wolf River at New London, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 16[a]	E. L. Williams	3.18	1,020	Apr. 16	E. L. Williams	7.31	4,350
Feb. 7[a]	.....do	3.33	874	June 18	R. B. Kilgore	6.48	3,280
Mar. 7[a]	.....do	3.59	927	Aug. 25	.....do	2.00	1,160

[a] Complete ice cover.

Daily discharge, in second-feet, of Wolf River at New London, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,280	3,100	2,560	1,140	910	910	8,060	4,050	1,810	2,500	1,050	1,100
2	2,340	3,160	2,500	1,140	910	910	7,780	4,160	1,910	2,440	1,050	1,080
3	2,280	3,220	2,500	1,140	910	910	7,510	4,270	1,960	2,280	1,050	1,050
4	2,280	3,220	2,560	1,140	875	910	7,000	4,270	2,060	2,170	1,075	1,000
5	2,170	3,220	2,560	1,140	875	910	6,530	4,270	2,170	2,060	1,100	1,080
6	2,060	3,220	2,500	1,140	875	910	6,530	4,270	2,220	1,960	1,160	1,130
7	2,010	3,220	2,440	1,140	875	910	6,310	4,270	2,560	1,860	1,080	1,220
8	1,910	3,160	2,390	1,140	840	930	5,900	4,160	2,860	1,810	1,160	1,370
9	1,710	3,160	2,280	1,100	840	945	5,710	3,950	2,980	1,660	1,190	1,460
10	1,560	3,220	2,220	1,100	840	960	5,360	3,760	3,100	1,420	1,260	1,420
11	1,420	3,220	2,010	1,100	840	980	5,200	3,500	3,220	1,420	1,330	1,330
12	1,460	3,160	1,710	1,060	840	1,000	4,920	3,350	3,350	1,510	1,460	1,260
13	1,560	3,100	1,660	1,060	875	1,020	4,780	3,220	3,580	1,560	1,460	1,260
14	1,510	3,040	1,610	1,020	875	1,040	4,510	3,040	3,760	1,560	1,330	1,260
15	1,560	2,980	1,560	1,020	875	1,060	4,390	2,920	3,850	1,560	1,420	1,290
16	1,510	2,740	1,460	1,020	875	1,060	4,160	2,800	3,670	1,510	1,560	1,330
17	1,560	2,740	1,370	1,020	875	1,060	4,050	2,680	3,580	1,330	1,760	1,370
18	1,560	2,680	1,320	980	875	1,060	3,950	2,500	3,500	1,330	1,860	1,330
19	1,560	2,680	1,280	980	875	1,100	3,850	2,340	3,280	1,290	1,860	1,330
20	1,560	2,620	1,240	980	875	1,120	3,850	2,280	3,160	1,260	1,660	1,290
21	1,660	2,500	1,240	980	875	1,190	3,850	2,220	3,040	1,330	1,370	1,190
22	1,810	2,500	1,240	980	875	1,320	3,850	2,280	2,860	1,290	1,260	1,160
23	1,960	2,620	1,190	945	875	1,610	3,850	2,170	2,680	1,220	1,220	1,050
24	2,060	2,860	1,190	945	875	2,340	3,760	2,220	2,560	1,100	1,160	1,020
25	2,280	3,040	1,190	945	875	3,500	3,850	2,170	2,560	1,130	1,100	1,020
26	2,500	2,980	1,190	945	875	4,780	3,850	2,170	2,680	1,190	1,080	1,000
27	2,620	2,860	1,190	945	910	5,360	3,950	2,010	2,620	1,190	1,080	1,009
28	2,740	2,860	1,140	945	910	5,900	3,950	1,960	2,620	1,160	1,050	965
29	2,800	2,800	1,140	910	....	5,900	3,950	1,760	2,620	1,130	1,080	965
30	2,920	2,620	1,140	910	....	5,710	3,950	1,760	2,560	1,100	1,100	1,000
31	3,100	....	1,140	910	....	5,530	....	1,760	....	1,020	1,100	

NOTE.—Stage-discharge relation affected by ice Dec. 14 to Mar. 31.

Monthly discharge of Wolf River at New London, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 2,240 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	3,100	1,420	2,010	0.897	1.03
November	3,220	2,500	2,950	1.32	1.47
December	2,560	1,140	1,700	.759	.88
January	1,140	910	1,030	.460	.53
February	910	840	875	.391	.41
March	5,900	910	2,030	.906	1.04
April	8,060	3,760	4,970	2.22	2.48
May	4,270	1,760	2,990	1.33	1.53
June	3,850	1,810	2,850	1.27	1.42
July	2,500	1,020	1,530	.683	.79
August	1,860	1,050	1,270	.567	.65
September	1,460	965	1,180	.527	.59
The year	8,060	840	2,120	.946	12.82

WEST BRANCH OF WOLF RIVER AT NEOPIT, WIS.

LOCATION.—In sec. 20, T. 29 N., R. 14 E., at dam and power plant at Neopit, Shawano County, a station on Wisconsin Northern Railroad, 20 miles north of Shawano; about 11 miles above confluence of Wolf River and West Branch.

DRAINAGE AREA.—108 square miles.

RECORDS AVAILABLE.—January 25, 1911, to February 7, 1917, when station was discontinued.

GAGE.—Vertical staff, head and tail race gages.

DETERMINATION OF FLOW.—Observations of the head of water flowing over the spillway, the head on the wheels, and the kilowatt output as measured at the switchboard are taken at 6, 7, and 10 a. m. and at 3, 6, and 10 p. m. The flow at these times is determined by means of a curve developed by current-meter measurements, and the computed discharge is then weighted in accordance with the elapsed interval.

EXTREMES OF DISCHARGE.—Maximum daily discharge recorded during year, 169 second-feet, January 7; minimum daily discharge, 62 second-feet December 10.

1911–1917: Maximum daily discharge, 999 second-feet, July 24, 1912; minimum daily discharge, 17 second-feet, August 30, 1914. Extremes are caused by regulation, and are not natural.

ACCURACY.—Rating tables used in determination of daily discharge based on numerous measurements made throughout the year. Conditions relative to leakage and plant equipment are becoming more unsatisfactory; records published for year only fair.

Daily discharge, in second-feet, of West Branch of Wolf River at Neopit, Wis., for the period Oct. 1, 1916, to Feb. 7, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Day.	Oct.	Nov.	Dec.	Jan.	Feb.
1	122	132	112	100	123	16	106	121	82	89	
2	122	122	110	102	117	17	103	123	66	94	
3	115	132	105	108	125	18	130	110	87	93	
4	110	122	113	100	106	19	103	105	90	105	
5	84	113	106	101	137	20	95	113	92	114	
6	76	124	110	98	131	21	103	114	96	103	
7	84	127	116	169	125	22	90	109	86	119	
8	79	124	116	112		23	89	116	87	124	
9	149	91	109	104		24	68	113	96	106	
10	128	106	62	95		25	71	80	89	95	
11	103	100	107	94		26	149	99	104	115	
12	116	112	110	101		27	153	121	91	140	
13	86	114	104	102		28	132	117	92	98	
14	74	106	95	83		29	131	116	105	140	
15	74	82	82	96		30	139	100	98	118	
						31	152		98	119	

Monthly discharge of West Branch of Wolf River at Neopit, Wis., for the period Oct. 1, 1915, to Feb. 7, 1917.

[Drainage area, 108 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	153	68	108	1.00	1.15
November	132	80	112	1.04	1.16
December	116	62	97.0	.898	1.04
January	169	83	108	1.00	1.15
February 1-7	137	106	123	1.14	.30

LITTLE WOLF RIVER AT ROYALTON, WIS.

LOCATION.—In sec. 1, T. 22 N., R. 13 E., at highway bridge at Royalton, Waupaca County, about 4 miles above mouth of river.

DRAINAGE AREA.—485 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—January 13, 1914, to September 30, 1917.

GAGE.—Sloping gage on left bank 150 feet upstream from highway bridge; read by J. C. Jenson. Prior to August 21, 1915, a chain gage fastened to upstream side of highway bridge was used. Datum of sloping gage is 0.75 foot higher than that of the chain gage; owing to change in slope, however, difference between readings on the slope gage and the chain gage is not constant.

DISCHARGE MEASUREMENTS.—Made by wading or from cable about 500 feet upstream from chain gage.

CHANNEL AND CONTROL.—Stream bed at gage consists of heavy gravel and rock; fairly permanent; at measuring section bed is fine, smooth gravel. Neither bank is overflowed to any extent at flood stages.

EXTREMES OF DISCHARGE.—Maximum discharge recorded during year, about 4,800 second-feet March 26; minimum discharge recorded, about 130 second-feet January 23.

1914–1917: Maximum stage recorded, 7.5 feet at 7.15 p. m., June 7, 1914 (discharge, 5,350 second-feet); a higher stage was recorded in March, 1917, but discharge was less owing to backwater from ice; minimum discharge recorded, about 130 second-feet March 5 and 6, 1916, and January 23, 1917.

ICE.—Stage-discharge relation affected by ice.

REGULATION.—The few power plants above the station have little storage and produce no observable diurnal fluctuation at the gage.

ACCURACY.—Stage-discharge relation not permanent. Two rating curves used during the year; one applicable for periods when slope gage was read—October 1 to November 15, November 21–24, December 1–6, and June 19 to September 30—well defined between 209 and 1,570 second-feet; the other, applicable to chain-gage readings, poorly defined throughout. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except for period when stage-discharge relation was affected by ice, for which it was obtained by applying to rating table mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good except for high stages, for which they are fair; winter records fair.

Discharge measurements of Little Wolf River at Royalton, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 16[a]	E. L. Williams	[b]1.98	166	Apr. 16	E. L. Williams	2.47	719
Feb. 7[a]	.....do	[b]2.40	176	June 19	R. B. Kilgore	1.86	392
Mar. 7[a]	.....do	[b]2.72	243	Aug. 25	.....do	1.35	214

[a] Almost complete ice cover. [b] Gage height referred to chain gage.

Daily discharge, in second-feet, of Little Wolf River at Royalton, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	680	800	496	160	250	175	1,680	1,150	384	501	193	221
2	560	740	474	185	235	190	1,450	1,010	428	417	193	221
3	444	740	433	170	210	205	1,300	978	424	397	207	219
4	371	710	442	170	195	185	1,300	749	438	381	227	225
5	376	680	406	200	180	185	1,220	640	469	371	301	267
6	337	650	402	215	145	240	1,150	615	615	318	284	352
7	314	650	385	195	175	240	1,150	542	911	323	245	439
8	276	680	380	175	175	230	1,080	478	1,220	284	337	530
9	297	740	370	160	170	240	1,050	496	1,080	301	293	386
10	314	710	360	160	160	240	978	478	944	289	305	356
11	284	680	355	170	170	635	911	496	846	310	347	318
12	280	615	345	165	170	450	846	469	720	332	305	301
13	314	566	340	165	180	385	846	442	615	366	305	356
14	314	474	335	160	195	615	749	428	566	332	276	337
15	376	442	325	145	195	405	666	397	519	323	301	328
16	361	450	320	155	180	280	666	388	456	318	366	386
17	371	450	310	160	190	260	615	328	442	289	402	301
18	397	450	305	150	175	260	666	388	446	305	501	318
19	386	475	295	165	180	320	776	420	347	310	227	310
20	392	475	290	175	170	385	1,010	442	371	323	241	276
21	461	492	280	160	185	450	1,050	496	407	318	241	280
22	590	542	275	150	185	665	978	478	439	267	234	257
23	590	542	270	130	165	1,560	944	496	461	280	241	267
24	560	542	260	135	195	2,080	846	469	530	270	215	276
25	740	540	255	145	150	3,490	720	446	830	276	205	280
26	865	520	260	150	195	4,560	776	460	680	245	207	276
27	935	520	240	170	205	4,340	776	380	560	236	227	270
28	1,010	495	250	135	190	3,390	776	371	560	227	211	241
29	935	495	230	255	....	2,430	776	362	530	186	215	243
30	935	495	235	270	....	1,760	911	384	501	193	225	227
31	900	....	175	240	....	1,760	....	433	....	186	219	....

NOTE.—Stage-discharge relation affected by ice Nov. 16–20, 25–30, and Dec. 7 to Mar. 31.

Monthly discharge of Little Wolf River at Royalton, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 485 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area.)
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,010	280	515	1.06	1.22
November	800	442	579	1.19	1.33
December	496	175	326	.672	.77
January	270	130	172	.355	.41
February	250	145	185	.381	.40
March	4,560	175	1,050	2.16	2.49
April	1,680	615	955	1.97	2.20
May	1,150	328	520	1.07	1.23
June	1,220	347	591	1.22	1.36
July	501	186	306	.631	.73
August	402	193	268	.553	.64
September	530	219	302	.623	.70
The year	4,560	130	482	.994	13.48

WAUPACA RIVER NEAR WEYAUWEGA, WIS.

Location.—On line between sec. 1, T. 21 N., R. 12 E., and sec. 6, T. 21 N., R. 13 E., at highway bridge 2½ miles west of Weyauwega, Waupaca County.

Drainage area.—308 square miles (measured on Wisconsin Geological and Natural History Survey map, edition of 1911; scale 1 inch=6 miles).

Records available.—June 28, 1916, to October 18, 1917, when station was moved one mile upstream.

Gage.—Chain gage bolted to top chord, downstream truss, across left channel; read by Otto Reek and Harry Radtke.

Discharge measurements.—Made from downstream side of bridge or by wading about 300 feet above bridge.

Channel and control.—Bed composed of coarse gravel; clean and free from aquatic grass. Control is a fairly well defined riffle about 30 feet downstream from gage. Right bank high, wooded, and will be overflowed only occasionally; left bank low and subject to overflow; road is high, so that during ordinary flood stages all the water passes under the bridge.

Ice.—Stage-discharge relation affected by ice.

Extremes of discharge.—Maximum stage recorded during period of records 6.1 feet March 23, 1917; owing to ice effect maximum discharge occurred about March 25, and has been estimated at 920 second-feet. Minimum discharge about 130 second-feet, February 13, 1917.

Regulation.—Several power plants at Waupaca and above on the main stream and also several on the Crystal River cause slight fluctuations during low stages. The pondage at the various plants is small; mean monthly discharge is believed to represent nearly the natural flow.

Accuracy.—Stage-discharge relation assumed practically permanent. Rating curve based on 7 current-meter measurements made in 1916 and 1917 and 4 measurements made in 1918 at the new site 1 mile upstream; curve fairly well defined between 158 and 448 second-feet; above 448 second-feet rating curve is an extension and subject to possible error. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to the rating table; except for periods when the stage-discharge relation was affected by ice, for which it was obtained by applying to rating table gage height corrected for ice effect by means of discharge measurements, observer's notes, and weather records. Records probably not better than fair for entire period.

Discharge measurements of Waupaca River near Weyauwega, Wis., during the period Oct. 1, 1916, to Oct. 26, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 12[a]	E. L. Williams	2.32	170	June 9	W. G. Hoyt	1.99	404
Feb. 3[a]	do	2.87	170	July 7	R. B. Kilgore	1.50	250
Mar. 6[a]	do	3.02	176	Sept. 7	do	1.58	[b]265
Apr. 17	do	1.68	327	Oct. 26	do	1.63	[b]289

[a] Complete ice cover at control. [b] Discharge measured at the site of new station one mile upstream.

Daily discharge, in second-feet, of Waupaca River near Weyauwega, Wis., for the period June 28, 1916 to Nov. 18, 1917.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1916.					1916.				
1		303	168	178	16		238	200	318
2		350	168	178	17		275	200	250
3		289	178	200	18		289	178	303
4		262	238	158	19		238	200	262
5		225	275	238	20		262	189	250
6		238	238	200	21		250	275	262
7		225	262	189	22		212	158	250
8		212	225	200	23		212	158	238
9		212	250	275	24		178	158	225
10		189	238	200	25		200	158	200
11		212	262	250	26		200	168	262
12		212	262	540	27		200	158	470
13		200	200	540	28	225	178	158	565
14		178	225	388	29	250	212	158	333
15		189	200	303	30	318	158	178	289
					31		178	178	

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1916–17.													
1	262	350	225	160	145	160	710	590	262	262	178	178	178
2	250	303	210	170	160	150	590	493	303	250	225	178	189
3	238	275	205	180	170	145	590	428	303	238	200	178	200
4	225	333	205	190	170	180	590	388	275	238	178	168	189
5	303	318	210	185	160	160	590	333	303	225	189	262	189
6	200	289	210	180	150	180	590	303	368	238	200	303	168
7	238	303	210	170	150	180	516	275	650	250	212	275	189
8	200	318	205	170	160	180	448	289	448	238	303	225	189
9	238	303	205	170	180	180	408	262	388	262	225	200	200
10	225	333	200	180	180	190	408	225	333	250	238	238	238
11	225	318	200	180	150	190	368	250	303	250	200	225	250
12	225	303	200	170	150	180	368	262	275	250	200	189	275
13	275	289	200	190	130	180	350	238	318	250	250	238	212
14	238	285	200	180	160	190	368	238	289	238	250	303	200
15	275	275	200	150	160	200	318	275	275	225	250	250	250
16	250	275	200	150	170	225	318	250	275	200	238	238	178
17	238	275	195	160	170	240	289	250	250	262	200	225	238
18	225	275	195	160	170	250	303	238	238	238	212	250	225
19	212	275	190	155	150	275	470	250	262	212	189	200	
20	250	275	190	150	150	335	540	250	250	225	189	212	
21	333	275	185	180	160	450	470	262	262	200	189	189	
22	303	255	185	145	160	600	388	318	262	212	189	178	
23	275	250	185	145	160	770	368	289	275	212	189	178	
24	275	250	185	160	170	890	350	275	303	225	178	178	
25	428	250	185	180	145	950	350	250	333	200	189	189	
26	448	250	180	180	200	920	428	262	388	225	178	178	
27	368	245	190	160	180	890	388	225	318	250	200	178	
28	318	240	195	180	180	830	408	225	303	178	200	168	
29	470	235	195	170		770	428	238	303	200	178	168	
30	408	230	180	180		830	493	225	275	178	178	168	
31	368		160	150		830		250		189	168		

NOTE.—Stage-discharge relation affected by ice Nov. 14, 1916, to Mar. 28, 1917.

Monthly discharge of Waupaca River near Weyauwega, Wis., for the period July 1, 1916, to Sept. 30, 1917.

[Drainage area, 308 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1916.					
July	350	158	225	0.731	0.84
August	275	158	202	.656	.76
September	565	158	284	.922	1.03
1916-17.					
October	470	200	283	.919	1.06
November	350	230	282	.916	1.02
December	225	160	196	.636	.73
January	190	145	169	.549	.63
February	200	130	162	.526	.55
March	950	145	410	1.33	1.53
April	710	289	440	1.43	1.60
May	590	225	287	.932	1.07
June	650	238	313	1.02	1.14
July	262	178	228	.740	.85
August	303	168	205	.666	.77
September	303	168	210	.682	.76
The year	950	130	266	.864	11.71

SHEBOYGAN RIVER NEAR SHEBOYGAN, WIS.

LOCATION.—In sec. 28, T. 15 N., R. 23 E., 2 miles west of Sheboygan, Sheboygan County, and 2½ miles above mouth.

DRAINAGE AREA —403 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles.

RECORDS AVAILABLE.—June 30, 1916, to September 30, 1917.

GAGE.—Chain gage fastened to upstream side of bridge; read by Hattie Opgenorth.

DISCHARGE MEASUREMENTS.—Made from highway bridge, or by wading; at extreme flood stages, measurements are made from Chicago & North Western Railway bridge, one-third mile downstream.

CHANNEL AND CONTROL.—Control, well defined riffle about 200 feet below bridge. Stream bed composed of heavy gravel; clear and free from aquatic grass. Both banks are of medium height and are rarely overflowed.

EXTREMES OF DISCHARGE.—1916-17: Maximum discharge 1,490 second-feet March 22 to 24; minimum stage recorded, 1.84 feet at 6.30 p. m., September 2, 1916 (discharge, 16 second-feet).

ICE.—Stage-discharge relation affected by ice.

REGULATION.—At low stages there is a small amount of diurnal fluctuation due to operation of small power plants above.

ACCURACY.—Stage-discharge relation permanent, except when affected by ice. Rating curve well defined between 58 and 1,040 second-feet, poorly defined outside these limits. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except for periods when stage-discharge relation was affected by ice, for which it was obtained by applying to rating curve mean daily gage height corrected for effect of ice by means of discharge measurements, observers' notes, and weather records. Open-water records excellent; winter records fair.

Discharge measurements of Sheboygan River near Sheboygan, Wis., during year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 5[a]	H. C. Beckman	3.16	100	Apr. 13	E. L. Williams	2.98	354
Feb. 8[a]	E. L. Williams	3.42	64	18	.....do	2.71	252
Mar. 9[a]	.....do	3.57	74	June 8	W. G. Hoyt	4.19	892

[a] Complete ice cover.

Daily discharge, in second-feet, of Sheboygan River near Sheboygan, Wis., for the period June 30, 1916, to Sept. 30, 1917.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1916.					1916.				
1		149	62	53	16		115	58	62
2		96	54	23	17		112	58	53
3		107	53	44	18		58	62	54
4		91	56	26	19		83	62	66
5		83	181	37	20		54	56	70
6		78	132	64	21		66	51	47
7		83	83	66	22		70	54	45
8		83	83	81	23		62	56	60
9		53	70	62	24		53	51	74
10		54	58	66	25		62	54	34
11		66	99	54	26		66	58	62
12		62	83	62	27		62	70	62
13		58	99	54	28		49	47	78
14		64	76	58	29		47	49	135
15		51	62	51	30	159	32	44	115
					31		49	51	

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1916–17.												
1	78	305	347	120	60	60	1,090	1,340	326	244	99	110
2	66	216	368	115	40	40	992	1,090	805	284	99	49
3	68	212	347	110	50	40	944	624	1,440	264	66	62
4	60	264	347	105	40	40	897	536	1,090	305	107	72
5	40	244	368	100	40	70	897	515	713	264	104	216
6	64	228	494	125	40	90	897	515	851	204	81	91
7	94	264	473	85	40	60	805	431	992	212	166	96
8	70	326	326	90	65	40	624	536	805	139	126	101
9	66	347	325	95	50	80	431	326	558	185	115	94
10	76	390	325	105	80	70	410	284	897	126	94	66
11	54	284	305	120	60	80	624	264	897	104	121	40
12	58	244	305	105	50	205	431	174	713	166	104	83
13	94	244	285	70	50	390	368	139	668	115	149	66
14	54	232	285	55	40	580	264	146	668	139	81	91
15	66	236	270	70	40	715	244	135	494	121	101	107
16	74	160	255	50	65	850	264	129	431	189	42	88
17	88	135	245	50	50	715	264	146	410	228	78	99
18	88	146	225	50	40	850	305	152	264	99	76	91
19	62	452	205	70	40	945	452	132	347	126	78	86
20	99	494	185	85	40	1,040	624	264	224	166	99	94
21	126	410	165	50	70	1,290	580	91	159	135	146	94
22	208	452	130	55	80	1,490	473	389	115	264	110	99
23	212	944	130	50	80	1,490	389	410	368	146	110	86
24	149	536	145	40	80	1,490	494	389	624	166	101	76
25	181	450	165	40	60	1,390	410	284	494	216	76	70
26	389	430	150	65	80	1,340	452	284	494	170	156	99
27	244	430	140	105	50	1,340	494	264	410	146	81	81
28	200	450	135	40	60	1,290	410	264	536	181	83	72
29	212	450	130	40		1,240	431	193	668	86	70	81
30	212	452	115	40		1,190	536	244	580	170	58	91
31	264		100	40		1,140		284		132	94	

NOTE.—Stage-discharge relation affected by ice Nov. 16, Nov. 25–29; Dec. 9 to Mar. 31.

Monthly discharge of Sheboygan River near Sheboygan, Wis., for the period July 1, 1916, to Sept. 30, 1917.

[Drainage area, 403 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1916.					
July	149	32	71.5	0.177	0.20
August	181	44	68.8	.171	.20
September	135	23	60.6	.150	.17
1916-17.					
October	389	40	123	.305	.35
November	944	135	348	.864	.96
December	494	100	251	.623	.72
January	125	40	75.5	.187	.22
February	80	40	55.0	.136	.14
March	1,490	40	698	1.73	1.99
April	1,090	244	550	1.36	1.52
May	1,340	91	354	.878	1.01
June	1,440	115	601	1.49	1.66
July	305	86	177	.439	.51
August	166	42	99.1	.246	.28
September	216	40	88.4	.219	.24
The year	1,490	40	286	.710	9.60

MILWAUKEE RIVER NEAR MILWAUKEE, WIS.

Location.—In NW. ¼ sec. 5, T. 7 N., R. 22 E., immediately above an old quarry near north limits of Milwaukee, Milwaukee County, about half mile below concrete highway bridge and 1 mile above Mineral Spring road; 5½ miles above confluence of Milwaukee and Menominee rivers.

Drainage area.—661 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

Records available.—April 30, 1914, to September 30, 1917.

Gage.—Chain gage fastened to cantilever arm supported by posts set in concrete foundations on the left bank of the river; read by Mrs. Joe Wangard.

Channel and control.—Bed of channel at gage heavy gravel. About 200 feet below the gage is a rock outcrop with a 4-foot fall which forms the control, and is probably permanent. Below the control the river flows in an artificial channel which at one time was a quarry. Left bank above and below the control high and not subject to overflow; right bank above control of medium height; below the control the right bank is artificial and of such height that overflow will rarely occur.

Discharge measurements.—Made by wading immediately above the gage section; at medium and high stages from the lower members of a wooden railroad bridge about 700 feet below the gage; bridge crosses an abandoned quarry and the channel beneath, being artificial, affords an excellent measuring section. During the summer of 1917 the bridge burned down and at present there is no suitable point for high-water measurements.

Extremes of discharge.—Maximum stage recorded during year 5.5 feet at 5 p.m. March 25 (discharge, about 5,160 second-feet); minimum stage recorded 0.62 foot at 5.30 a. m. September 2 (discharge 48 second-feet).

1914–1917: Maximum stage recorded 5.58 feet February 24, 1915 (discharge 5,280 second-feet); minimum stage recorded 0.50 foot at 8.30 p. m. August 2, 1916 (discharge, about 26 second-feet).

Ice.—Stage-discharge relation affected by ice.

REGULATION.—No diurnal fluctuation at the gage resulting from operation of small plants above.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve well defined between 88 and 3,710 second-feet; poorly defined outside these limits. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except for period when stage-discharge relation was affected by ice, for which it was obtained by applying to rating table mean of daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records excellent, except for extreme high and low stages, for which they are only fair; winter records fair.

Discharge measurements of Milwaukee River near Milwaukee, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 6	E. L. Williams	1.00	137	Mar. 1[a]	E. L. Williams	2.06	111
Dec. 27[a]	.....do	1.65	152	Apr. 12	.....do	1.66	576
Jan. 29[a]	.....do	1.93	119	Sept. 8	R. B. Kilgore	1.21	239

[a] Incomplete ice cover at control.

Daily discharge, in second-feet, of Milwaukee River near Milwaukee, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	282	692	569	110	100	115	1,040	2,140	360	1,680	109	109
2	282	692	532	140	100	120	952	1,900	610	1,460	104	56
3	225	610	494	175	100	145	908	1,570	1,790	1,040	83	66
4	195	532	427	165	95	150	864	1,220	1,680	777	106	62
5	166	494	420	135	110	115	927	908	1,570	610	106	114
6	154	494	427	125	145	140	1,090	650	1,570	460	83	140
7	154	460	347	100	115	690	1,090	569	1,680	460	109	230
8	140	400	295	130	130	1,420	952	494	1,570	427	88	235
9	140	820	265	165	105	1,680	864	427	1,460	360	114	225
10	150	997	235	175	100	1,790	734	373	1,220	276	120	169
11	120	908	210	120	115	2,020	650	367	908	235	120	140
12	177	777	185	130	130	2,140	569	307	692	276	86	143
13	177	908	165	100	165	2,020	427	292	532	215	106	177
14	177	820	145	100	75	2,260	414	276	532	215	127	181
15	166	532	130	115	115	2,760	400	253	864	190	109	185
16	177	650	130	80	130	2,380	394	220	864	177	88	169
17	177	650	130	100	115	2,260	367	185	610	169	58	146
18	177	610	130	100	115	2,260	414	173	494	215	86	154
19	235	494	145	110	130	2,380	864	195	460	205	80	133
20	494	569	145	95	145	2,380	1,360	185	394	162	74	146
21	650	569	120	115	120	2,760	1,360	294	307	162	83	143
22	734	650	140	120	115	2,500	1,180	569	288	133	78	140
23	734	1,090	165	100	145	3,990	952	1,040	1,900	136	62	114
24	692	1,460	170	90	140	4,270	734	1,180	1,360	150	74	146
25	1,180	777	115	80	145	5,160	692	997	1,220	276	74	154
26	1,460	692	130	55	115	4,410	820	692	1,270	241	78	150
27	1,360	864	155	100	100	3,290	820	569	1,040	210	96	181
28	1,220	908	185	110	130	2,500	734	494	1,220	169	109	177
29	908	734	210	120	....	1,790	650	427	2,020	166	96	185
30	734	610	175	100	....	1,360	734	334	1,680	140	74	166
31	650	....	185	115	....	1,130	....	334	....	109	60	....

NOTE.—Stage-discharge relation affected by ice Dec. 8 to Mar. 8.

Monthly discharge of Milwaukee River near Milwaukee, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 661 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,460	120	461	0.697	0.80
November	1,460	400	715	1.08	1.20
December	569	120	235	.356	.41
January	175	55	115	.174	.20
February	165	75	119	.180	.19
March	5,160	115	2,010	3.04	3.50
April	1,360	367	799	1.21	1.35
May	2,140	173	633	.958	1.10
June	2,020	288	1,070	1.62	1.81
July	1,680	109	371	.561	.65
August	127	60	916	.139	.16
September	235	56	151	.228	.25
The year	5,160	55	567	.858	11.62

LITTLE CALUMET RIVER AT HARVEY, ILL.

LOCATION.—In NW. ¼ sec. 9, T. 36 N., R. 14 E., at Illinois Central Railroad bridge 800 feet north of railroad station at 147th Street, Harvey, Cook County, about 11 miles above mouth of river.

DRAINAGE AREA.—570 square miles (measured on map issued by U. S. Geological Survey, scale 1:500,000).

RECORDS AVAILABLE.—Daily discharge, October 1, 1916, to September 30, 1917; also daily gage-height record collected by Sanitary District of Chicago, June 10, 1907, to September 30, 1916.

GAGE.—Vertical staff gage attached to bridge pier; read by Mrs. H. Wurtman.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed of river composed of clay and gravel. Low-water control is at "The Rocks," about a mile below gage; bed of river heavy gravel; probably permanent. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.1 feet March 14 (discharge, 1,120 second-feet); minimum stage, 2.96 feet at 5 p. m. August 27 (discharge, 48 second-feet).

1910-1917: Maximum stage recorded, 13.4 feet March 6, 1908 (discharge not determined); minimum stage, 2.9 feet August 10, 1916 (discharge, 39 second-feet).

ACCURACY.—Stage-discharge relation probably permanent throughout the year; seriously affected by ice during the winter. Rating curve well defined above and fairly well defined below 70 second-feet. Gage read to tenths three times daily October 1 to June 1, and to hundredths twice daily June 2 to September 30. Daily discharge ascertained by applying mean daily gage height to rating table. Open-water records good; winter records poor.

COOPERATION.—Gage-height records from October 1 to June 1 furnished by the Sanitary District of Chicago.

Discharge measurements of Little Calumet River at Harvey, Ill., during the year ending Sept. 30, 1917.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.
	Feet.	*Sec-ft.*
Apr. 13	5.00	681
June 2	4.48	437
Aug. 25	3.06	62.5

Daily discharge, in second-feet, of Little Calumet River at Harvey, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	70	170	194				481	309	600	107	86	60
2	70	148	170				519	309	444	115	77	64
3	70	148	170				519	278	374	103	75	59
4	70	148	170				481	248	358	94	74	54
5	70	148	170	290	150	180	642	220	358	83	70	54
6	70	148	170				726	194	726	81	68	60
7	70	127	170				684	194	684	99	67	70
8	70	127	220				684	170	481	103	65	84
9	70	148	309				684	148	408	99	70	81
10	70	148	309				684	148	408	98	65	81
11	70	148				358	684	127	374	96	64	77
12	83	148				444	642	127	341	99	60	74
13	107	127				462	642	127	358	107	59	74
14	107	127				1,120	600	127	391	119	57	70
15	107	127		250	120	769	559	107	358	115	56	70
16	107	127				642	519	107	325	127	57	68
17	107	107				600	519	107	294	263	59	67
18	107	107				600	481	88	263	278	57	62
19	127	107				600	481	88	248	278	56	57
20	159	107				600	444	88	220	278	54	54
21	194	107	200			600	444	107	207	248	54	62
22	194	107				600	408	170	170	234	52	75
23	194	142				769	408	220	148	444	57	84
24	220	170				855	408	194	131	408	67	81
25	248	170			150	726	408	194	127	309	64	74
26	220	170		190		684	374	194	127	263	59	67
27	220	170				642	341	855	115	207	50	74
28	220	170				559	341	600	123	170	52	74
29	194	194			......	519	341	444	119	144	51	70
30	194	194			......	519	341	408	111	119	56	70
31	170	......			......	519	......	559	......	105	60	......

NOTE.—Discharge Dec. 11 to Mar. 10 estimated, because of ice, from gage heights and weather records. Braced figures show mean discharge for periods indicated.

Monthly discharge of Little Calumet River at Harvey, Ill., for the year ending Sept. 30, 1917.

[Drainage area, 570 square miles]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	248	70	130	0.228	0.26
November	194	107	143	.251	.28
December	309	....	202	.354	.41
January	....	....	242	.425	.49
February	....	....	139	.244	.25
March	1120	....	483	.847	.98
April	726	341	516	.905	1.01
May	855	88	234	.411	.47
June	726	111	313	.549	.61
July	444	81	174	.305	.35
August	86	50	61.9	.109	.13
September	84	54	69.0	.121	.13
The year	1120	50	226	.396	5.37

GRAND RIVER AT GRAND RAPIDS, MICH.

LOCATION.—At Fulton Street Bridge, Grand Rapids.

DRAINAGE AREA.—4,900 square miles.

RECORDS AVAILABLE.—March 12, 1901, to September 30, 1917.

GAGE.—Staff, attached to bridge; read to half tenths October 1, 1916 to February 10, 1917, and to tenths after February 10, 1917; twice daily October 1 to January 5 and March 12 to May 26; once daily during remainder of year.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

EXTREMES OF STAGE.—Maximum stage recorded during year 8.8 feet at 5 p. m. April 10; minimum stage recorded, −1.5 feet, about 2 weeks in August.

ICE.—Stage-discharge relation somewhat affected by ice.

REGULATION.—Operation of power plants above station may modify low-water flow.

ACCURACY.—The two or three measurements made since 1905 indicate that the rating curve used in 1905 was not applicable after that year.

COOPERATION.—Records furnished by city engineer of Grand Rapids.

No discharge measurements made during the year.

Daily gage height, in feet, of Grand River at Grand Rapids, Mich., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		−0.88	−0.6		0.35	0.8		3.95	3.2		0.6	
2	−1.02	− .9	− .7	0.45	.55	.8	4.55	4.15	2.8	0.8	.0	
3	−1.0	− .88		.7	.85	.7	5.1	4.35		1.2		−1.0
4	−1.02	− .85	− .85	.45			5.15	4.1	2.65	1.5	− .6	
5	−1.12		− .75	.35	.9	.7	5.28	4.2	2.2	1.9		
6	−1.18	− .88	.7	.35	.9	.5	5.9		1.8	2.0	− .6	
7	−1.18	− .9	− .7		.9	.5	6.58	2.25	1.65	2.2		
8		− .88	− .7	.35	.9	.4		2.0	4.0		−1.0	− .3
9	−1.15	− .82	− .6	.15	.85	.5	8.4	1.6	4.2	2.3		
10	−1.2	− .8		.30	.5	.3	8.7	1.45		2.4	−1.0	
11	−1.18	− .8	− .5	.35			8.25	1.25	3.1	2.4		
12	−1.15		− .1	.35	.5	3.05	7.45	1.05	2.2	2.3		
13	−1.05	− .82	− .4	.4	.5	3.9	6.2		2.0	2.2	−1.5	−1.0
14	−1.1	− .82	− .5		.9	4.4	4.85	.55	1.9	2.3		
15		− .68	− .6	.7	1.0	4.4		.25	1.6		−1.5	−1.0
16	−1.15	− .7	− .35	.7	1.0	4.45	3.02	.3	1.2	2.5		
17	−1.1	− .7		.8	.6	4.6	2.85	.25		2.6	−1.5	−1.0
18	−1.12	− .65	− .5	.8			2.9	.35	.7	2.7		
19	−1.1		− .4	.7	.5	3.5	2.85	.4	.6	2.7		
20	− .9	− .8	− .5	.7	.5	3.25	4.3		.5	2.6		
21	− .7	− .8	− .5		.5	3.05	5.15	1.45	.5	2.6	−1.5	
22		− .75	− .5	.7	.5	2.85		2.6	.4			−1.0
23	− .72	− .5	− .5	.7	.5	3.15	5.9	3.1	.4	2.3		
24	− .75	.2		.4	.5	4.0	5.9	2.65				
25	− .75	.3		.4		4.4	6.4	2.7	.0	2.0	−1.5	−1.0
26	− .75		− .5	.4	.6	4.45	5.55	2.9	.0			
27	− .85	.3	.5	.35	.7	4.45	5.3		.1	1.5		
28	− .88	.35	.5		.7	4.32	5.0	3.9	− .1	1.3		
29		.3	.35	.3		4.45		4.1	.0			−1.0
30	− .9		.35	.35		4.45	3.9	3.9	.2			
31	− .85			.35		4.0		3.6		.8		

NOTE.—Gage read to top of ice, Jan. 15, 16, 22, Feb. 5, 15 and 16. Gage heights, Dec. 17-31, Jan. 8-13, 23, 24 and 29, estimated by observer owing to ice.

STREAMS TRIBUTARY TO LAKE HURON.

TITTABAWASSEE RIVER AT FREELAND, MICH.

LOCATION.—At Highway bridge at Freeland.

DRAINAGE AREA.—2,530 square miles.

RECORDS AVAILABLE.—August 22, 1903, to August 3, 1906; October 28, 1906, to December 31, 1909; January 1, 1912, to September 30, 1917.

COOPERATION.—Estimates of daily discharge were made and furnished by G. S. Williams, consulting engineer, Ann Arbor, Mich.

Daily discharge, in second-feet, of Tittabawassee River at Freeland, Mich., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,140	1,300	1,745	1,119	1,201	1,256	3,760	4,770	1,905	3,760	730	930
2	1,110	1,300	1,670	1,130	1,201	1,300	3,285	7,050	1,785	3,285	700	960
3	1,098	1,340	1,600	1,112	1,215	1,300	3,055	7,500	1,600	2,610	646	1,038
4	1,090	1,360	1,560	1,112	1,300	1,300	2,790	8,124	1,705	2,270	630	1,080
5	1,080	1,377	1,572	1,119	1,300	1,244	3,285	6,930	2,190	1,600	592	1,050
6	1,068	1,377	1,520	1,115	1,215	1,244	5,805	4,370	1,785	1,170	550	1,110
7	1,050	1,410	1,560	1,112	1,215	1,285	7,886	4,100	3,484	1,020	513	1,140
8	1,050	1,480	1,600	1,112	1,300	1,300	6,700	3,475	5,275	3,620	513	1,182
9	1,080	1,584	1,863	1,119	1,300	1,410	5,585	2,875	4,600	3,430	540	1,235
10	1,110	1,635	1,985	1,130	1,300	1,455	4,750	2,400	3,484	3,285	561	1,249
11	1,140	1,745	2,015	1,138	1,282	1,522	3,150	1,841	2,835	2,835	582	1,235
12	1,182	1,705	2,000	1,130	1,264	1,545	2,835	1,450	2,065	2,400	620	1,221
13	1,200	1,670	1,880	1,130	1,256	1,760	2,400	1,080	1,600	1,985	646	1,200
14	1,207	1,700	1,760	1,130	1,244	2,010	2,190	1,068	1,480	1,600	760	1,200
15	1,235	1,800	1,675	1,123	1,244	2,500	1,825	1,050	1,390	1,480	786	1,182
16	1,270	1,900	1,522	1,115	1,236	2,950	1,705	1,050	1,270	1,050	760	1,050
17	1,270	1,900	1,527	1,112	1,232	3,400	1,600	1,090	1,122	930	730	930
18	1,270	1,900	1,531	1,112	1,232	3,860	1,480	1,098	1,050	1,080	730	786
19	1,462	1,900	1,640	1,112	1,220	3,910	1,450	1,110	1,020	3,475	760	760
20	1,480	1,900	1,522	1,112	1,232	4,100	1,560	1,110	990	3,683	770	712
21	1,600	1,900	1,441	1,112	1,244	4,500	1,985	1,110	960	3,110	675	700
22	1,753	1,900	1,365	1,134	1,244	5,125	2,270	1,785	930	2,745	592	675
23	1,705	1,900	1,320	1,134	1,264	5,530	2,400	3,760	930	2,400	675	658
24	1,635	1,900	1,300	1,142	1,282	6,250	2,610	6,035	900	2,965	770	646
25	1,600	1,900	1,300	1,150	1,264	6,200	2,355	5,375	870	3,285	760	625
26	1,536	1,985	1,282	1,165	1,244	6,145	2,270	3,965	930	3,055	786	592
27	1,480	1,990	1,264	1,177	1,224	6,090	2,230	3,285	3,520	1,985	930	571
28	1,410	1,945	1,232	1,190	1,244	6,035	2,215	2,745	5,805	1,340	1,056	582
29	1,377	1,900	1,201	1,201	....	5,275	2,190	2,520	2,735	930	1,080	582
30	1,377	1,785	1,156	1,201	....	4,750	2,578	2,400	2,250	870	1,050	592
31	1,340	....	1,112	1,215	....	4,070	....	2,081	....	786	1,020	......

Monthly discharge of Tittabawassee River at Freeland, Mich., for the year ending Sept. 30, 1917.

[Drainage area, 2530 square miles]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,753	1,050	1,300	0.514	0.59
November	1,990	1,300	1,710	.676	.75
December	2,096	1,112	1,540	.609	.70
January	1,215	1,112	1,140	.451	.52
February	1,300	1,201	1,250	.494	.51
March	6,250	1,244	3,250	1.28	1.48
April	7,886	1,450	3,010	1.19	1.33
May	8,124	1,050	3,180	1.26	1.45
June	5,805	870	2,080	.822	.92
July	3,760	786	2,260	.893	1.03
August	1,080	513	726	.287	.33
September	1,249	571	916	.362	.40
The year	8,124	513	1,870	.739	10.01

NOTE.—Monthly and yearly discharge computed by engineers of the United States Geological Survey.

STREAMS TRIBUTARY TO LAKE ERIE.

HURON RIVER AT BARTON, MICH.

Location.—At dam and power plant of the Eastern Michigan Edison Co. at Barton, near Ann Arbor, 4 miles above the station at Geddes.

Drainage area.—723 square miles.

Record available.—January 1, 1914, to September 30, 1917.

Determination of discharge.—Flow computed from records of operation of power plant, the flow through under-sluices during floods, and the depth of flow over dam. The flow through the power house is determined from a calibration of the turbines by means of a specially constructed weir, the crest of which was formed by a ½-inch by 5-inch milled plate, the discharge over the weir being computed by Bazin's formula for free overflow. The greater part of the flood water passes through under-sluices in the power-house foundations, and this flow is determined from a weir calibration of the sluices. Water flows over crest of dam only a few days during the year.

Cooperation.—Daily-discharge record furnished by G. S. Williams, consulting engineer, Ann Arbor, Mich.

Daily discharge, in second-feet, of Huron River at Barton, Mich., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	160	237	285	322	300	428	886	822	770	780	202	125
2	165	230	309	279	291	429	958	818	800	655	162	129
3	187	227	247	349	304	428	959	786	770	593	167	135
4	172	279	306	304	259	357	952	759	729	532	166	147
5	158	209	376	369	288	358	1,112	717	670	530	225	193
6	213	210	354	361	268	343	1,669	671	734	537	145	247
7	160	236	327	387	235	358	1,581	674	969	489	107	387
8	131	203	330	378	314	441	1,392	625	842	514	114	369
9	179	242	409	408	235	387	1,215	625	874	470	130	348
10	151	287	356	407	249	454	1,132	546	969	434	140	331
11	147	246	371	304	215	786	1,132	523	804	386	138	244
12	162	191	382	315	196	810	1,059	524	850	406	125	220
13	188	256	358	320	213	799	987	509	693	449	130	244
14	235	238	330	244	211	814	935	511	810	392	127	207
15	108	232	235	349	234	778	933	408	745	335	131	246
16	193	262	253	280	238	809	861	430	679	392	132	204
17	175	186	215	273	313	794	808	410	575	436	133	200
18	177	319	313	313	164	753	791	397	561	302	126	202
19	250	139	252	238	266	690	1,021	405	500	340	118	188
20	189	226	266	289	245	755	1,032	369	457	332	135	197
21	293	217	274	223	255	741	1,014	407	475	328	134	181
22	222	282	262	283	246	741	988	618	438	286	121	231
23	243	232	270	250	308	772	953	736	462	337	130	85
24	173	261	178	264	366	814	939	707	501	283	125	177
25	255	341	305	237	319	838	938	636	538	287	121	177
26	258	230	276	278	301	853	929	590	472	282	120	158
27	250	283	279	266	416	950	951	666	498	248	129	158
28	334	337	316	137	438	970	941	685	441	256	166	157
29	236	261	333	359	....	969	847	639	766	173	131	193
30	275	263	338	343	....	890	834	679	792	225	133	100
31	336	....	326	215	....	865	....	704	....	173	165	......

Monthly discharge of Huron River at Barton, Mich., for the year ending Sept. 30, 1917.

[Drainage area, 723 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	336	108	206	0.285	0.33
November	341	139	245	.339	.38
December	409	178	304	.420	.48
January	408	137	301	.416	.48
February	438	164	278	.385	.40
March	970	343	683	.945	1.09
April	1,669	791	1,020	1.41	1.57
May	822	369	600	.830	.96
June	969	438	673	.931	1.04
July	780	173	393	.544	.63
August	225	107	140	.194	.22
September	387	85	206	.285	.32
The year	1,669	85	421	.582	7.90

NOTE.—Monthly and yearly discharge computed by engineers of the United States Geological Survey.

HURON RIVER AT FLAT ROCK, MICH.

LOCATION.—At the highway bridge at Flat Rock, 2,000 feet below the crossing of Detroit, Toledo & Ironton Railway.

DRAINAGE AREA.—1,000 square miles.

RECORDS AVAILABLE.—August 6, 1904, to September 30, 1917.

GAGE.—Staff; read daily, morning and evening, to tenths, by C. L. Metler.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Probably permanent.

EXTREMES OF STAGE.—Maximum stage recorded during year, 7.6 feet, at 5.30 p. m., April 7; minimum stage recorded, 1.0 foot, September 25 and 29.

ICE.—Ice jams form below the station and cause backwater at the gage; in general the section above the station is kept open by the power plant.

REGULATION.—At ordinary stages flow of the river is controlled by a dam and power plant immediately above station, but operation of this plant is assumed to have little effect on diurnal fluctuations of stage.

No discharge measurements were made at this station during the year.

Daily gage height, in feet, of Huron River at Flat Rock, Mich., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.1	1.85	1.7	1.9	3.0	3.9	4.5	4.35	3.5	4.1	1.6	1.4
2	1.05	1.8	1.95	2.9	3.1	4.0	5.2	4.1	3.7	3.9	1.55	1.4
3	1.4	1.8	1.6	2.45	2.6	3.7	5.4	4.0	3.8	3.35	1.65	1.3
4	1.5	1.8	1.5	2.9	....	3.3	5.0	3.8	3.5	3.0	1.55	1.45
5	1.35	1.5	1.9	2.65	2.25	3.15	5.2	3.75	3.45	2.75	....	1.55
6	1.25	1.65	2.15	3.3	3.0	3.55	6.45	3.5	3.75	2.95	1.4	1.6
7	1.4	1.65	1.9	3.6	2.65	3.3	7.45	3.3	4.45	3.1	2.3	2.05
8	1.6	1.7	1.9	3.0	2.8	3.9	7.1	3.6	4.8	2.8	1.6	1.8
9	1.45	1.5	1.85	2.95	2.85	4.95	6.25	3.25	4.6	2.7	1.6	1.8
10	1.4	1.4	1.9	3.0	3.0	3.9	5.7	3.15	4.5	2.75	1.4	1.8
11	1.25	1.7	1.75	3.0	2.6	4.6	5.2	2.95	4.1	2.75	1.4	2.0
12	1.3	1.8	2.0	2.7	2.6	5.5	5.25	2.9	4.0	1.75	1.2	1.8
13	1.45	1.65	1.9	2.55	2.85	6.0	5.0	2.5	4.05	2.45	1.2	1.55
14	1.4	1.7	1.75	2.6	2.4	5.9	4.85	2.7	3.9	2.65	1.65	1.8
15	1.5	1.7	1.9	2.45	2.5	5.85	4.6	2.75	3.3	2.5	1.15	1.65
16	1.4	1.6	1.85	2.95	2.85	5.4	4.4	2.3	3.6	2.3	1.55	1.4
17	1.3	1.65	1.8	2.8	2.45	5.15	4.2	2.2	3.6	3.0	1.4	1.45
18	1.3	1.55	2.05	2.75	3.0	5.1	4.0	2.3	3.2	3.15	1.4	1.8
19	1.4	1.4	1.7	2.55	3.0	4.75	4.85	2.15	2.8	2.7	1.4	1.5
20	1.8	1.55	2.7	2.65	3.0	4.3	6.45	....	2.8	2.7	1.25	1.6
21	1.95	1.5	2.4	2.7	3.15	3.7	6.05	1.9	2.6	2.15	1.35	1.6
22	1.8	1.5	2.2	2.15	3.0	3.75	5.35	2.75	2.4	2.0	1.45	1.35
23	1.55	1.65	2.45	2.95	2.7	3.7	5.0	3.9	2.55	1.9	1.4	1.4
24	1.75	1.8	2.0	2.75	3.3	4.35	4.85	4.0	3.8	2.1	1.4	1.4
25	1.8	1.8	2.0	2.65	3.5	4.1	4.8	3.75	3.8	2.0	1.65	1.3
26	1.85	1.6	1.95	2.65	3.35	4.4	4.8	2.35	3.25	2.0	1.5	1.45
27	1.75	1.55	2.65	2.7	4.25	4.3	4.8	2.8	2.8	1.75	1.4	1.4
28	1.7	1.7	3.1	2.5	4.2	4.8	4.7	3.4	2.75	1.7	1.45	1.55
29	1.8	1.85	3.0	2.35	....	4.75	4.3	3.55	3.2	1.6	1.5	1.3
30	1.65	1.8	2.75	3.0	....	3.35	4.0	3.5	4.45	1.5	1.65	1.4
31	1.85	....	2.6	3.9	....	4.25	....	3.35	....	1.65	1.35	....

CATTARAUGUS CREEK AT VERSAILLES, N. Y.

Location.—At the three-span highway bridge in Versailles, Cattaraugus County, 2½ miles above mouth of Clear Creek, about 6 miles below Gowanda, and about 8 miles above mouth of stream.

Drainage area.—467 square miles (measured on post-route map).

Records available.—September 23, 1910, to September 30, 1917.

Gage.—Chain on upstream side of right span of bridge; read by James Palmer.

Discharge measurements.—Made from downstream side of bridge or by wading.

Channel and control.—Bed composed of rock and gravel; shifting.

Extremes of discharge.—Maximum stage recorded during year, 8.2 feet at 9 a. m. March 17 (discharge, about 8,460 second-feet); minimum stage recorded, 4.45 feet October 7, 8, and 11 (discharge, 64 second-feet).

1910–1917: Maximum stage recorded, 11.6 feet at 5.40 p. m. March 25, 1913 (discharge, roughly 30,000 second-feet); minimum stage recorded, 4.65 feet August 21 and September 6, 7, 1913 (discharge, 55 second-feet).

Ice.—Stage-discharge relation seriously affected by ice.

Accuracy.—Stage-discharge relation not permanent; affected by ice during much of the period December to March, inclusive. Gage read to half-tenths twice daily. Daily discharge throughout year ascertained by indirect method, applying mean daily effective gage height to rating table; corrections for obtaining effective gage heights determined from discharge measurements. Records fair.

Discharge measurements of Cattaraugus Creek at Versailles, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 18[a]	C. S. DeGolyer	5.00	247	May 29	E. D. Burchard	6.22	2,190
Feb. 8[b]	E. D. Burchard	8.00	450	June 27	.....do	6.06	1,870
Mar. 14	.....do	6.52	2,750	July 13	C. S. DeGolyer	5.24	555
14	.....do	6.61	3,080	Aug. 31	J. W. Moulton	4.83	239
May 29	.....do	6.26	2,240	31	.....do	4.82	231

[a] Incomplete ice cover at gage and control. [b] Measurement made through complete ice cover.

Daily discharge, in second-feet, of Cattaraugus Creek at Versailles, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	98	134	570	340	1,100	1,190	4,030	404	1,440	592	310	200
2	82	178	386	400	900	920	3,130	493	1,190	738	551	180
3	98	154	310	400	750	795	2,120	474	1,810	522	325	625
4	90	154	294	460	650	703	1,350	456	1,050	430	234	297
5	75	154	261	1,800	550	703	1,190	772	920	386	200	200
6	82	143	261	2,800	500	3,000	1,350	1,190	1,710	371	189	200
7	70	143	231	1,400	480	1,520	1,810	920	5,380	310	180	278
8	75	98	178	600	440	1,050	1,520	920	2,120	493	166	920
9	98	114	178	700	440	858	1,050	680	1,440	551	166	551
10	98	143	178	550	440	920	920	551	2,350	456	166	386
11	64	154	189	320	420	4,680	920	592	1,910	1,350	180	245
12	90	189	200	260	380	6,900	1,350	493	1,120	920	166	200
13	124	178	190	340	320	1,910	1,050	493	795	570	180	166
14	348	203	180	400	260	2,350	795	456	680	3,570	200	166
15	203	231	160	380	200	1,810	703	386	592	2,020	189	166
16	154	203	140	300	150	1,120	703	371	570	1,270	189	143
17	134	203	130	300	110	1,910	658	386	551	658	189	143
18	105	203	120	240	130	1,620	570	371	474	551	166	143
19	124	203	110	240	260	858	592	386	493	493	166	143
20	189	245	100	240	240	985	570	920	456	430	143	325
21	217	278	95	240	190	1,620	592	703	404	456	143	258
22	203	217	90	420	150	1,620	493	772	371	430	143	258
23	154	231	90	900	140	2,020	493	920	371	430	200	200
24	134	1,520	95	900	300	5,750	493	1,050	2,020	371	217	166
25	114	709	160	800	1,200	2,020	474	1,620	920	348	217	152
26	203	386	280	650	5,000	1,910	404	920	570	278	180	143
27	154	386	700	550	4,600	2,020	404	920	658	348	166	124
28	154	430	1,270	480	2,000	2,120	404	1,520	592	297	166	152
29	143	920	703	600	......	2,240	386	2,350	570	1,190	551	166
30	154	1,050	522	1,500	......	1,520	386	1,520	625	795	474	180
31	134	......	371	1,400	......	1,520	......	1,050	......	456	217	......

NOTE.—Discharge, Dec. 13–27 and Jan. 15 to Feb. 26, estimated because of ice from discharge measurements, weather records, study of gage-height graph and comparison with records for stations on streams in adjacent drainage basins.

Monthly discharge of Cattaraugus Creek at Versailles, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 467 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	348	64	134	0.287	0.33
November	1,520	98	319	.683	.76
December	1,270	90	282	.604	.70
January	2,800	240	675	1.45	1.67
February	5,000	110	796	1.70	1.77
March	6,900	703	1,940	4.15	4.78
April	4,030	386	1,030	2.21	2.47
May	2,350	371	808	1.73	1.99
June	5,380	371	1,140	2.44	2.72
July	3,570	278	712	1.52	1.75
August	551	143	223	.478	.55
September	920	124	249	.532	.59
The year	6,900	64	692	1.48	20.08

STREAMS TRIBUTARY TO LAKE ONTARIO.

LITTLE TONAWANDA CREEK AT LINDEN, N. Y.

Location.—At stone-arch highway bridge in Linden, Genesee County, 3 miles above junction with Towanda Creek.

Drainage area.—22.0 square miles (measured on topographic maps).

Records available.—July 8, 1912, to September 30, 1917.

Gage.—Vertical staff on upstream side of right abutment; lower 2 feet of enameled iron, graduated to hundredths of a foot; upper 4 feet of bronze, graduated to half-tenths; read by C. L. Schenck.

Discharge measurements.—Made from cable 1,000 feet above gage or by wading near gage.

Channel and control.—A standard Francis weir, 2.01 feet long and 8 inches high, has been constructed under the upstream side of the bridge. When the water overtops this weir it flows over a 2-inch plank about 13 feet long, including the 2 feet of weir. During the winter of 1916–17 crest of weir was worn down by ice passing over it and it was necessary to develop a new rating curve. A tree that lodged against the weir June 26 was partly removed June 28 and entirely removed July 14. Crest of weir was repaired August 20.

Extremes of discharge.—Maximum stage during year, from water marks on gage, 9.5 feet in early morning of June 27 (discharge not computed); minimum stage recorded, 0.20 foot October 8 and 9 (discharge, 0.51 second-foot).

1912–1917: Maximum stage, determined by leveling from flood marks, 14.6 feet during flood of April 22, 1916 (discharge, about 2,400 second-feet); minimum stage recorded, 0.18 foot August 20 and 21, September 14–16, and October 8, 1913 (discharge, 0.43 second-foot).

Accuracy.—Stage-discharge relation permanent except for changes caused by wearing of crest of weir by ice. Rating curve used October 1 to March 11 and August 21 to September 30, when weir was in good condition, well defined below 250 second-feet and fairly well defined between 250 and 750 second-feet; curves for period during which weir was obstructed by tree or when crest was in damaged condition are fairly well defined. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good for period when weir was in good condition; fair for rest of year.

Discharge measurements of Little Tonawanda Creek at Linden, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 28	E. D. Burchard	[a]1.06	27.3	July 14	C. S. DeGolyer	[c]1.10	24.9
28	.....do	[a]1.07	28.4	14	.....do	[c]1.06	23.4
28	.....do	[a]1.55	66.3	Aug. 21	.....do	[d].44	1.54
28	.....do	[a]1.62	73.0	21	.....do	.44	1.58
June 28	.....do	[b]1.64	56.8	Sept. 1	J. W. Moulton	.64	2.9
28	.....do	[b]1.63	57.5	1	.....do	.62	2.9
28	.....do	[c]1.52	54.6	1	.....do	.62	2.8
28	.....do	[c]1.49	53.1				

[a] Crest of weir worn by ice.
[b] Tree lodged against weir.
[c] Portion of tree removed.
[d] Tree entirely removed and weir repaired.

Daily discharge, in second-feet, of Little Tonawanda Creek at Linden, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	0.68	0.91	3.07	7.2	16	59	314	17	62	84	3.9	3.21
2	.68	.87	2.72	6.1	10.4	47	166	25	33	74	3.5	3.36
3	.63	.87	2.38	6.1	6.6	22	95	19	28	33	3.22	4.6
4	.59	.82	2.51	9.7	6.9	17	57	17	23	23	3.22	2.93
5	.59	.91	6.1	55.0	6.4	13	49	40	47	19	2.90	2.38
6	.59	.87	3.21	91.0	4.9	12	90	55	60	15	2.78	2.18
7	.55	.82	3.00	37	4.6	12	80	36	365	13	2.66	2.79
8	.51	.82	2.79	22	4.6	13	90	26	214	32	2.54	4.6
9	.51	.96	2.79	13	4.2	11.1	62	23	80	22	2.54	4.2
10	.59	1.39	2.72	9.7	3.9	10.7	45	20	142	74	2.42	3.07
11	.59	1.81	2.45	8.7	4.1	302	62	17	189	29	2.20	2.65
12	.59	1.51	2.38	8.1	3.6	335	66	23	71	36	2.20	2.65
13	.77	1.45	2.79	6.1	3.36	136	76	18	44	25	2.10	2.12
14	.87	1.93	2.25	4.9	3.36	100	47	16	33	24	2.90	2.05
15	.72	2.12	2.51	6.1	3.36	45	39	14	26	24	2.30	1.87
16	.68	2.12	2.38	5.3	3.28	56	36	11.5	28	18	2.20	1.74
17	.68	1.99	2.51	3.07	3.21	116	32	11.0	23	16	2.20	1.74
18	.63	2.12	2.25	3.6	5.6	71	30	11.0	26	20	2.20	1.62
19	.77	2.45	2.25	4.6	7.2	47	30	10.0	80	16	2.00	1.62
20	1.07	2.72	2.12	5.1	12	76	29	34	33	12	1.80	2.05
21	1.07	2.79	2.18	4.6	20	116	26	21	23	10	1.74	1.74
22	.91	2.25	1.99	5.1	10	126	23	31	19	8.2	1.74	1.51
23	.87	2.18	1.99	6.1	8.4	183	23	29	16	7.4	1.74	1.51
24	.77	5.1	2.18	6.4	32	305	22	100	42	6.8	1.74	1.45
25	.77	3.5	2.58	5.6	20	148	18	80	28	6.1	1.74	1.45
26	.87	2.86	2.65	4.6	99	166	20	38	121	5.6	1.68	1.45
27	.77	2.45	3.36	4.2	235	189	17	31	290	5.2	1.51	1.39
28	.87	2.51	34.0	3.9	87	100	16	55	53	4.6	1.74	1.99
29	.77	3.07	20.0	4.1	......	160	14	95	61	10	3.6	1.51
30	.82	3.6	12.0	17	......	71	17	62	34	5.6	3.21	1.51
31	.77	......	8.4	29	......	90	......	35	......	4.6	2.65	......

Monthly discharge of Little Tonawanda Creek at Linden, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 22.0 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1.07	0.51	0.73	0.033	0.04
November	5.1	.82	1.99	.090	.10
December	34	1.99	4.72	.215	.25
January	91	3.07	13.0	.591	.68
February	235	3.21	22.5	1.02	1.06
March	335	10.7	102	4.64	5.35
April	314	14	56.4	2.56	2.86
May	100	10	32.9	1.49	1.72
June	365	16	76.5	3.47	3.87
July	84	4.6	22.0	1.00	1.15
August	3.9	1.51	2.42	.110	.13
September	4.6	1.39	2.30	.105	.12
The year	365	.51	28.1	1.28	17.33

GENESEE RIVER AT SCIO, N. Y.

Location.—At steel highway bridge one-fourth mile above Vandermark Creek, half a mile above Scio, Allegany County, and 1 mile above Knight Creek.

Drainage area.—297 miles (measured on map issued by United States Geological Survey, scale, 1:500,000).

Records available.—June 12, 1916, to September 30, 1917.

Gage.—Vertical staff attached to downstream face of left bridge abutment; read by Raymond Sisson.

Discharge measurements.—Made from downstream side of bridge or by wading.

Channel and control.—Coarse gravel; probably permanent.

Extremes of discharge.—Maximum stage recorded during year, 5.1 feet July 2 (discharge, 3,710 second-feet); minimum discharge recorded, 26 second-feet February 13.

1916–17: Maximum stage recorded, 8.7 feet at 8 a. m. June 17, 1916 (discharge, about 9,800 second-feet); minimum stage recorded, 0.60 foot August 25, 26, 1916 (discharge, 25 second-feet).

Ice.—Stage-discharge relation affected by ice.

Accuracy.—Stage-discharge relation practically permanent; affected by ice during much of period December to March. Rating curve well defined between 25 and 5,500 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Open-water records good; winter records fair.

Discharge measurements of Genesee River at Scio, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 26	E. D. Burchard	0.78	53.4	Mar. 12	E. D. Burchard	5.59	4,480
26	.....do	.80	56.2	12	.....do	4.84	3,340
Dec. 30[a]	C. S. DeGolyer	1.66	120	12	.....do	4.40	2,790
Jan. 20[a]	.....do	2.34	98	28	C. C. Covert	3.11	1,390
Feb. 10[a]	E. D. Burchard	2.08	65.4	May 31	E. D. Burchard	2.19	679
Mar. 12	.....do	5.78	4,670	31	.....do	2.17	675

[a] Measurement made through complete ice cover.

Daily discharge, in second-feet, of Genesee River at Scio, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	41	69	438	140	130	720	1,680	194	690	412	490	815
2	41	64	361	100	120	464	1,490	186	600	3,710	361	990
3	47	69	220	70	100	438	1,400	154	545	1,400	298	720
4	45	57	265	85	100	302	920	147	490	815	247	464
5	43	61	242	190	110	386	885	331	438	660	228	386
6	43	57	220	2,000	100	990	990	850	438	545	198	336
7	38	59	242	1,000	100	600	990	690	3,050	464	186	298
8	43	64	242	340	110	220	850	630	1,780	660	114	307
9	41	69	265	340	90	198	750	630	2,100	815	412	283
10	41	66	198	340	46	198	572	850	1,580	660	220	220
11	49	64	178	320	48	1,150	545	630	1,680	885	162	194
12	45	98	158	280	46	3,310	630	545	1,150	690	121	170
13	53	114	240	280	26	1,070	572	490	815	518	132	151
14	49	158	140	220	40	990	660	438	660	464	1,680	125
15	45	121	150	280	60	750	490	412	572	412	1,150	118
16	43	108	160	260	90	630	464	283	545	326	690	91
17	43	108	60	260	110	990	361	312	464	283	518	88
18	43	111	90	200	160	750	361	279	412	251	386	88
19	55	77	60	120	180	518	336	260	386	885	298	88
20	53	77	65	90	180	490	312	545	288	720	247	88
21	49	59	70	90	160	850	288	412	274	412	216	85
22	53	55	60	95	130	690	302	600	242	293	172	80
23	51	59	90	220	100	990	274	600	220	260	322	69
24	66	386	60	220	90	2,560	242	545	1,310	386	336	61
25	53	220	75	280	100	920	229	572	438	361	216	61
26	43	224	90	190	140	1,230	202	490	312	490	198	61
27	61	202	95	180	2,100	1,580	202	518	780	464	162	72
28	66	220	180	100	720	1,490	186	1,070	386	279	128	83
29	61	690	170	110	....	1,150	174	1,230	720	1,880	143	83
30	64	572	120	110	....	920	288	955	490	1,150	336	83
31	66	....	120	100	....	920	....	750	....	690	361	......

NOTE.—Discharge, Dec. 13 to Feb. 27, estimated because of ice from discharge measurements, weather records, study of gage-height graph and comparison with records for stations at St. Helena and Jones Bridge.

Monthly discharge of Genesee River at Scio, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 297 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	66	38	49.5	0.167	0.19
November	572	55	145	.488	.54
December	438	60	165	.556	.64
January	2,000	70	278	.936	1.08
February	2,100	26	196	.660	.69
March	3,310	198	918	3.09	3.56
April	1,680	174	588	1.98	2.21
May	1,230	147	535	1.80	2.08
June	3,050	220	796	2.68	2.99
July	3,710	251	717	2.41	2.78
August	1,680	121	346	1.16	1.34
September	990	61	226	.762	.85
The year	3,710	26	415	1.40	18.95

GENESEE RIVER AT ST. HELENA, N. Y.

Location.—At steel highway bridge in St. Helena, Wyoming County, 5½ miles below Portageville and site of proposed storage dam of New York Conservation Commission and 9½ miles above mouth of Canaseraga Creek.

Drainage area.—1,030 square miles.

Records available.—August 14, 1908, to September 30, 1917.

Gage.—Gurley seven-day water-stage recorder, installed July 22, 1916. Prior to that date a chain gage fastened to upstream side of bridge, middle span, installed August 14, 1908, and a Gurley printing water-stage recorder, installed August 24, 1911. Water-stage recorder inspected and chain gage read by Herman Piper.

Discharge measurements.—Made from bridge or by wading.

Channel and control.—Gravel and rocks; shifting occasionally.

Extremes of discharge.—Maximum stage during year, from water-stage recorder, 8.70 feet at 11 a. m. March 12 (discharge, 16,700 second-feet); minimum stage, from water-stage recorder, 1.80 feet at 1 a. m. October 2 (discharge, 50 second-feet).

1908–1917: Maximum stage, from water-stage recorder, 12.81 feet at 8 a. m. May 17, 1916 (discharge, 43,500 second-feet); minimum stage recorded, 1.70 feet at 5 p. m. October 5 and 8 a. m. October 17, 1913 (discharge, about 18 second-feet).

Ice.—Stage-discharge relation somewhat affected by ice.

Accuracy.—Stage-discharge relation not permanent. Rating curve for water-stage recorder, used October 1 to March 12 and September 17–30, well defined between 75 and 2,000 second-feet and fairly well defined between 2,000 and 30,000 second-feet; rating curve for chain gage, used March 12 to September 16, well defined between 500 and 1,600 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for days of great range in stage, when it was determined by averaging results obtained by applying to rating table gage heights for 2-hour periods. Records good.

Discharge measurements of Genesee River at St. Helena, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.		Discharge.	Date.	Made by—	Gage height.		Discharge.
		Chain.	Hook.				Chain.	Hook.	
		Feet.	*Feet.*	*Sec.-ft.*			*Feet.*	*Feet.*	*Sec.-ft.*
Dec. 29a	C. S. De Golyer	4.08	4.03	990	May 26	E. D. Burchard	3.96	4.00	1,440
Jan. 29b	do	5.09	5.07	300	June 22	do	3.18	3.31	648
Feb. 22b	do	5.03	5.04	459	27	C. S. De Golyer	4.72	4.91	2,500
Mar. 16	E. D. Burchard	4.40	4.22	2,010	Sept. 14	J. W. Moulton	2.72	2.70	338
Apr. 13	C. S. De Golyer	4.24	4.45	1,800	14	do	2.72	2.70	321
May 18	E. D. Burchard	3.24	3.24	707	26	do	2.51	2.49	198
18	do	3.24	3.24	717					

a Measurement made through incomplete ice cover.
b Measurement made through complete ice cover.

Daily discharge, in second-feet, of Genesee River at St. Helena, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	81	177	1,760	420	900	4,180	5,850	482	2,510	1,040	1,200	550
2	104	189	1,190	460	900	2,740	7,610	550	2,340	3,450	940	1,480
3	111	201	890	380	650	2,090	4,810	590	2,030	3,660	760	2,030
4	110	209	738	380	480	1,480	3,050	496	1,360	2,030	590	1,040
5	107	167	672	1,100	440	738	2,340	760	1,140	1,300	454	670
6	104	193	624	5,000	320	680	2,680	2,030	1,480	1,040	428	670
7	134	174	530	4,200	280	792	4,330	3,250	9,990	895	386	670
8	84	160	457	2,400	280	921	3,050	2,340	4,330	1,420	332	1,090
9	142	159	436	2,800	220	820	2,510	1,610	4,100	1,810	326	1,040
10	100	180	436	1,900	170	765	1,880	2,510	5,320	1,360	590	670
11	124	229	429	1,400	320	5,200	1,680	1,880	7,610	3,880	392	496
12	114	236	370	850	320	15,500	2,100	1,360	3,250	2,180	314	416
13	126	239	328	650	280	4,330	1,610	990	2,180	1,420	309	368
14	209	259	260	700	260	3,880	1,300	1,040	1,610	3,250	428	326
15	195	325	220	700	220	3,450	1,200	850	1,300	3,660	2,680	356
16	198	415	260	600	220	2,030	940	670	1,140	1,540	2,030	270
17	180	376	220	460	220	3,050	940	715	1,040	1,040	1,040	247
18	170	350	190	360	260	3,450	940	670	940	1,040	760	234
19	170	312	170	340	340	1,960	850	590	1,140	1,250	590	234
20	228	396	170	360	460	1,740	850	990	940	1,140	468	590
21	285	485	170	400	500	3,450	805	1,360	715	895	392	392
22	299	436	170	500	420	3,050	760	1,300	590	760	386	292
23	275	376	130	650	380	4,100	760	1,880	510	670	368	247
24	236	1,590	150	700	420	10,700	670	1,480	4,570	510	410	238
25	224	1,310	170	750	600	4,570	630	2,030	2,030	895	550	220
26	196	910	200	380	3,200	4,570	590	1,360	1,300	670	356	204
27	173	810	220	340	10,600	5,060	510	1,140	2,510	940	326	204
28	170	810	360	240	7,270	5,320	496	2,680	1,420	760	276	212
29	113	2,480	900	280	....	4,100	489	4,810	990	4,570	386	216
30	175	2,740	700	360	....	3,250	454	3,450	1,360	4,810	404	200
31	169	....	500	600	....	3,050	....	2,180	....	1,810	550	......

NOTE.—Discharge, Dec. 14 to Feb. 26, estimated because of ice from discharge measurements, weather records, study of gage-height graph and comparison with records for Scio, Jones Bridge and Rochester. Record Mar. 13 to Sept. 16 obtained by using mean daily gage height determined from 2 readings of chain gage per day; water-stage recorder in operation during rest of year.

Monthly discharge of Genesee River at St. Helena, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 1,030 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	299	81	165	0.160	0.18
November	2,740	159	563	.547	.61
December	1,760	130	452	.439	.51
January	5,000	240	989	.960	1.11
February	10,600	170	1,100	1.07	1.11
March	15,500	680	3,580	3.47	4.00
April	7,610	454	1,890	1.84	2.05
May	4,810	482	1,550	1.50	1.73
June	9,990	510	2,390	2.32	2.59
July	4,810	510	1,800	1.75	2.02
August	2,680	276	627	.609	.70
September	2,030	204	529	.513	.57
The year	15,500	81	1,340	1.30	17.18

GENESEE RIVER AT JONES BRIDGE, NEAR MOUNT MORRIS, N. Y.

LOCATION.—At highway bridge known as Jones Bridge, 1½ miles below Canaseraga Creek, 1½ miles above mouth of Beads Creek, 5 miles below Mount Morris, Livingston County, and 6 miles by river above Geneseo.

DRAINAGE AREA.—1,410 square miles.

RECORDS AVAILABLE.—May 22, 1903, to April 30, 1906; August 12, 1908, to December 31, 1913; July 12, 1915, to September 30, 1917.

GAGE.—Gurley seven-day water-stage recorder installed September 11, 1915, on right bank 60 feet downstream from bridge. Prior to 1915 a chain gage fastened to upstream side of highway bridge was used. Datum of water-stage recorder, 2.73 feet higher than that of chain gage (540.00 feet Conservation Commission datum). Recorder inspected by Theron S. Trewer.

DISCHARGE MEASUREMENTS.—Made from footbridge erected on lower chord of upstream bridge truss.

CHANNEL AND CONTROL.—Sandy clay; likely to shift but, as shown by discharge measurements, fairly permanent in recent years.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 23.5 feet at 2.30 p. m. March 12 (discharge, 31,800 second-feet); minimum stage, from water-stage recorder, 0.63 foot at 6 p. m. October 2 (discharge, 92 second-feet).

1902–1917: Maximum stage recorded, 25.44 feet at noon May 17, 1916 (discharge, 55,100 second-feet); minimum stage recorded, 2.7 feet at 6 p. m. August 29, 1909 (discharge, about 18 second-feet). See paragraph headed "Records available" for limits of periods of no records.

ICE.—Stage-discharge relation affected by ice.

REGULATION.—Some diurnal fluctuation due to operation of mills at Mount Morris is observable during extremely low water.

ACCURACY.—Stage-discharge relation practically permanent between dates of shifting; affected by ice for much of January, February, and March. Rating curve well defined between 150 and 7,000 second-feet and fairly well defined between 7,000 and 60,000 second-feet. Operation of water-stage recorder satisfactory throughout year. Daily discharge ascertained by applying to rating table mean daily gage height obtained by inspecting recorder graph or, for days of considerable fluctuation, by discharge integrator.

Discharge measurements of Genesee River at Jones Bridge, near Mount Morris, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 27	E. D. Burchard	1.29	259	May 23	E. D. Burchard	4.74	2,210
Jan. 1[a]	C. S. De Golyer	3.38	620	23	.....do	4.75	2,230
18[b]	E. D. Burchard	4.18	487	25	.....do	5.12	2,370
Feb. 16[b]	C. C. Covert	2.38	302	June 20	.....do	3.74	1,550
Mar. 9	O. W. Hartwell	8.99	1,140	29	.....do	4.10	1,680
15	E. D. Burchard	12.25	4,990	July 14	.....do	7.25	3,870
30	O. W. Hartwell	7.49	4,040	Aug. 24	C. S. De Golyer	2.09	613
30	.....do	7.06	3,720				

a Measurement made through incomplete ice cover.
b Measurement made through complete ice cover.

NOTE.—Gage heights of discharge measurements July 28 and Aug. 5, 1915, as published in Water-Supply Paper 404, p. 69, are in error. Correct gage height of measurement July 28 is 3.90 feet; that for Aug. 5 is 4.01 feet.

Daily discharge, in second-feet, of Genesee River at Jones Bridge, near Mount Morris, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	166	254	1,860	650	1,700	6,000	5,990	715	2,540	1,600	2,080	765
2	118	288	1,240	700	1,800	2,800	7,130	740	3,030	3,510	1,200	1,200
3	154	271	962	650	1,600	1,600	6,420	790	2,150	5,560	915	1,960
4	160	305	780	600	950	1,000	3,900	740	1,780	2,610	815	1,370
5	161	254	730	800	650	1,100	2,820	953	1,420	1,840	700	920
6	152	271	680	7,000	600	1,100	3,190	2,180	1,720	1,420	640	815
7	153	264	612	5,500	500	1,200	4,390	3,630	9,440	1,600	565	815
8	139	246	545	3,400	480	1,200	3,900	2,960	9,360	1,660	525	1,190
9	125	254	502	2,600	480	1,100	3,240	2,150	4,800	2,220	506	1,420
10	183	254	502	1,900	400	1,100	2,340	2,680	4,980	2,000	665	920
11	149	288	502	1,300	340	3,200	2,020	2,280	8,530	4,030	640	715
12	161	323	460	900	300	14,000	2,410	1,720	4,630	3,240	515	615
13	165	341	379	750	280	13,000	2,410	1,480	2,890	2,150	470	540
14	231	360	340	850	280	8,000	1,780	1,300	2,220	3,130	520	484
15	254	399	300	800	280	5,500	1,480	1,080	1,780	5,710	1,990	448
16	271	502	400	600	280	2,000	1,360	948	1,540	2,410	2,080	399
17	271	502	420	500	280	2,000	1,250	892	1,420	1,660	1,330	381
18	254	460	400	460	400	3,200	1,170	892	1,220	1,540	948	365
19	238	419	360	400	500	1,700	1,110	815	2,310	1,600	790	361
20	264	460	320	320	650	1,500	1,080	1,030	1,300	1,780	690	815
21	360	545	340	340	700	3,400	1,080	1,480	1,280	1,300	615	740
22	399	568	340	420	700	3,400	1,030	1,420	1,000	1,300	555	492
23	399	502	280	460	650	4,890	975	2,010	865	1,000	565	403
24	341	978	260	600	700	10,700	975	1,900	3,510	840	590	369
25	323	1,560	320	850	1,000	8,560	865	2,150	3,330	892	590	357
26	305	1,020	360	750	1,800	5,530	815	1,900	1,980	1,030	550	334
27	254	935	420	500	7,500	5,530	790	1,480	4,220	920	452	319
28	254	830	500	380	10,000	6,630	765	2,630	2,710	1,150	416	327
29	225	1,580	1,000	380	....	4,970	715	5,780	1,720	2,800	470	323
30	186	2,480	1,200	550	....	4,130	690	4,500	1,660	8,150	565	371
31	238	....	850	900	....	3,310	....	2,960	....	2,570	615	......

NOTE.—Discharge, Dec. 14 to Mar. 22, determined, because of ice, from discharge measurements, weather records, study of gage height graph and comparison with records for Rochester and St. Helena. Discharge, Aug. 19, 24 and 25, estimated; no gage-height record.

Monthly discharge of Genesee River at Jones Bridge, near Mount Morris, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 1,410 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	399	118	228	0.162	0.19
November	2,480	246	590	.419	.47
December	1,860	260	586	.416	.48
January	7,000	320	1,190	.844	.97
February	10,000	280	1,280	.908	.95
March	14,000	1,000	4,300	3.05	3.52
April	7,130	690	2,270	1.61	1.80
May	5,780	715	1,880	1.33	1.53
June	9,440	865	3,040	2.16	2.41
July	8,150	840	2,360	1.67	1.92
August	2,080	416	794	.563	.65
September	1,960	271	681	.483	.54
The year	14,000	118	1,600	1.13	15.43

GENESEE RIVER AT ROCHESTER, N. Y.

LOCATION.—At Elmwood Avenue Bridge at north end of South Park, 3¼ miles below mouth of Black Creek, 3½ miles above center of city of Rochester, Monroe County, and 7½ miles above mouth of river.

DRAINAGE AREA.—2,360 square miles.

RECORDS AVAILABLE.—February 9, 1904, to September 30, 1917. Fragmentary records prior to this period published in Water-Supply Papers 24, 65 and 97.

GAGE.—Gurley water-stage recorder installed in December, 1910, in the pump house on right bank, immediately below the bridge. Recorder inspected by George A. Bailey. Prior to December, 1910, a staff gage bolted to downsteam end of first pier from right abutment. Elevation of zero of gage, 506.848 feet, Barge Canal datum, and 245.591 feet, Rochester City datum.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge. Prior to 1904 measurements and elevation of water surface taken in conjunction with the city of Rochester.

CHANNEL AND CONTROL.—Smooth gravel; apparently permanent.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 7.38 feet at 7 p. m. March 14 (discharge, 14,200 second feet); minimum stage, from water stage recorder, 0.95 foot at 12 p. m. October 9 (discharge, 214 second-feet.)

1904–1917: Maximum stage, from water-stage recorder, 15.3 feet at midnight March 30, 1916 (discharge, 48,300 second-feet); minimum stage from water-stage recorder, 0.71 foot from 10 p. m. September 30 to 4 a. m. October 1, 1913 (discharge, 154 second-feet.

ICE.—Stage-discharge relation affected by ice during a large part of the period from December to March.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve well defined between 2,000 and 44,000 second-feet. Operation of water-stage recorder satisfactory throughout year. Daily discharge ascertained by applying to rating table mean daily gage height obtained by averaging hourly gage heights. Open-water records good; other records fair.

COOPERATION.—Water-stage recorder inspected by an employee of the Rochester Railway & Light Co.

Discharge measurements of Genesee River at Rochester, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 2[a]	C. S. De Golyer	1.71	859	Mar. 16	E. D. Burchard	5.27	8,090
17[a]	E. D. Burchard	2.20	756	May 16	.....do	2.04	1,490
Feb. 7[a]	.....do	2.00	794	17	.....do	1.94	1,320
Mar. 8[a]	O. W. Hartwell	2.04	1,220	June 20	.....do	3.22	3,430

[a] Measurement made through complete ice cover.

Daily discharge, in second-feet, of Genesee River at Rochester, N. Y., for the year ending Sept. 30, 1917.

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	282	375	1,880	1,100	950	9,500	4,800	1,100	3,580	2,760	2,760	880
2	258	375	1,370	850	1,500	7,000	8,600	1,110	3,490	3,400	1,880	1,060
3	266	393	1,110	800	2,000	4,600	8,600	1,110	3,300	6,050	1,440	1,210
4	274	402	980	800	1,800	3,200	7,030	1,160	2,080	5,350	1,250	2,060
5	274	411	884	800	1,300	2,400	4,700	1,160	2,260	3,210	1,020	2,000
6	290	393	800	1,400	950	1,600	4,600	2,180	2,260	2,260	932	2,900
7	274	411	740	5,500	750	1,260	7,280	3,780	5,460	2,040	860	2,620
8	282	411	718	4,400	500	1,200	7,540	4,380	13,300	2,080	788	1,040
9	243	384	685	2,600	500	1,500	6,050	3,490	10,300	2,590	729	1,180
10	243	393	608	2,000	500	1,700	4,600	2,760	6,580	3,030	696	1,740
11	290	402	586	1,800	480	2,400	3,400	3,120	11,500	3,120	812	1,370
12	266	402	641	1,300	440	8,060	3,120	2,590	11,200	5,020	824	1,070
13	274	470	597	1,000	420	13,000	3,580	2,100	6,530	3,780	707	884
14	282	520	510	850	460	14,000	3,210	1,880	4,380	2,940	824	788
15	306	520	520	850	480	13,000	2,590	1,650	3,210	5,000	908	707
16	314	553	402	900	500	8,870	2,260	1,440	2,680	5,400	2,340	652
17	366	630	348	850	460	5,930	2,100	1,290	2,340	2,940	2,180	608
18	393	641	430	750	420	6,530	2,000	1,240	2,020	2,340	1,520	586
19	366	575	402	700	500	6,050	1,840	1,230	2,260	2,760	1,150	597
20	375	586	402	650	750	4,280	1,760	1,270	3,120	2,850	944	575
21	366	619	393	600	950	4,490	1,710	1,640	2,340	2,500	848	824
22	402	685	411	600	1,100	5,810	1,640	2,060	1,940	2,020	764	1,290
23	440	788	470	750	1,100	5,700	1,540	2,260	1,590	1,800	685	980
24	520	1,230	520	850	1,000	8,330	1,510	2,760	2,340	1,440	685	729
25	490	1,520	375	700	1,200	12,400	1,470	2,760	4,700	1,180	696	674
26	450	1,070	375	1,100	1,500	8,870	1,340	3,030	3,400	1,240	707	641
27	430	1,110	430	1,100	4,400	7,030	1,280	2,500	5,240	1,370	696	586
28	411	1,040	460	850	11,000	7,540	1,240	2,180	6,050	1,300	660	564
29	375	1,920	500	650	....	7,540	1,150	4,600	3,880	1,440	630	553
30	348	2,500	750	650	....	6,290	1,100	6,780	2,850	5,020	650	564
31	348	....	1,200	700	....	5,020	....	5,240	....	5,930	740	....

NOTE.—Discharge, Dec. 28 to Mar. 11, estimated because of ice from discharge measurements, weather records, study of gage-height graph and comparison with similar studies for St. Helena and Jones Bridge. Discharge estimated, because of no gage heights, for the following periods: June 9, 10, July 15, 16, and Aug. 28 to Sept. 2.

Monthly discharge of Genesee River at Rochester, N. Y., for the year ending Sept. 30, 1917.

[Drainage Area, 2,360 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	520	243	339	0.144	0.17
November	2,500	375	724	.307	.34
December	1,880	348	661	.280	.32
January	5,500	600	1,240	.525	.61
February	11,000	420	1,350	.572	.60
March	14,000	1,200	6,290	2.67	3.08
April	8,600	1,100	3,450	1.46	1.63
May	6,780	1,100	2,450	1.04	1.20
June	13,300	1,590	4,560	1.93	2.15
July	6,050	1,180	3,040	1.29	1.49
August	2,760	630	1,040	.441	.51
September	2,900	553	1,060	.449	.50
The year	14,000	243	2,190	.928	12.60

CANASERAGA CREEK NEAR DANSVILLE, N. Y.

Location.—At highway bridge 1 mile west of Dansville, Livingston County, 2,200 feet below mouth of Mill Brook and about 22 miles above mouth of creek.

Drainage area.—167 square miles (measured by engineers of the State of New York Conservation Commission).

Records available.—July 21, 1910, to December 31, 1912; July 10, 1915, to June 30, 1917, when station was discontinued.

Gage.—Vertical staff at downstream side of left abutment; datum lowered 4.77 feet (to Conservation Commission datum, 640.00 feet) July 10, 1915. Gage read by Floyd Harter.

Discharge measurements.—Made from bridge or by wading.

Channel and control.—Sand and gravel; shifting frequently.

Extremes of discharge.—Maximum stage recorded during year, 9.3 feet at 7 a. m. June 11 (discharge, about 2,380 second-feet); minimum stage recorded, 5.2 feet several times during October and November (discharge, about 15 second-feet).

1910–1912 and 1915–1917: Maximum stage recorded, 13.0 feet at 9.30 p. m. May 16, 1916 (discharge, determined from logarithmic extension of rating curve roughly, 6,600 second-feet); minimum stage recorded, 5.2 feet several times during October and November, 1916.

Ice.—Stage-discharge relation affected by ice; observations of stage discontinued during winter.

Accuracy.—Stage-discharge relation not permanent; frequent discharge measurements necessary for determination of discharge; affected by ice December to March. Rating curve not well defined. Gage read to half tenths twice daily. Daily discharge October 1 to December 12 ascertained by applying daily gage height to rating table; March 1 to June 30, by shifting-control method. Records fair.

Discharge measurements of Canaseraga Creek near Dansville, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 19[a]	E. D. Burchard	6.15	44.7	July 12	C. S. DeGolyer	7.00	407
Mar. 9	O. W. Hartwell	6.00	98.7	12	do	6.92	344
29	do	6.88	365	16	E. D. Burchard	6.57	203
29	do	6.88	371	16	do	6.55	204
May 22	E. D. Burchard	6.38	178	31	C. C. Covert	6.45	143
22	do	6.38	177	Aug. 25	C. S. DeGolyer	5.94	52.7
June 23	do	6.20	112	Sept. 20	E. D. Burchard	6.32	132
23	do	6.20	116	20	do	6.30	127

[a] Measurement made through complete ice cover.

Daily discharge, in second-feet, of Canaseraga Creek near Dansville, N. Y., for the peri Oct. 1, 1916, to June 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.
1	32	18	50	1,030	730	39	31
2	28	15	39	928	730	36	2[illegible]
3	21	16	28	653	291	34	1[illegible]
4	20	15	26	538	271	36	1[illegible]
5	19	18	25	460	175	80	1[illegible]
6	18	16	28	443	281	382	2[illegible]
7	18	15	25	162	276	271	1,78
8	18	15	42	82	231	198	1,00
9	18	16	25	69	109	240	46
10	18	16	25	95	136	253	1,26
11	16	16	25	1,330	125	162	2,24
12	15	19	24	920	125	131	1,54
13	25	28	24	355	120	125	1,02
14	32	23	24	257	112	100	71
15	18	21	24	139	107	90	49
16	16	20	22	65	102	75	28
17	15	21	22	69	102	79	13
18	18	20	22	218	102	75	26
19	18	21	22	214	97	73	1,70
20	23	20	22	126	86	136	1,10
21	23	23	20	114	71	109	59
22	21	30	20	90	65	158	20
23	20	42	20	597	60	168	8
24	21	102	20	1,140	56	206	1,38
25	20	128	20	558	68	179	43
26	20	54	20	372	125	191	41
27	18	36	24	432	66	223	1,18
28	16	68	26	366	58	253	52
29	16	71	28	460	45	231	41
30	15	59	24	286	43	912	23
31	15	....	22	149	....	674	....

NOTE.—Discharge, Dec. 12-31, estimated because of ice from one discharge measurement, weathe records and study of gage-height graph. Discharge for January and February not computed because o ice.

Monthly discharge of Canaseraga Creek near Dansville, N. Y., for the period Oct. 1, 1916, to June 30, 1917.

[Drainage area, 167 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	32	15	19.7	0.118	0.14
November	128	15	32.7	.196	.22
December	50	20	25.3	.151	.17
March	1,330	65	410	2.45	2.82
April	730	43	166	.994	1.11
May	912	34	191	1.14	1.31
June	2,240	86	692	4.14	4.62

CANASERAGA CREEK AT GROVELAND STATION, N. Y.

LOCATION.—At highway bridge at Groveland Station, Livingston County.

DRAINAGE AREA.—195 square miles (measured by engineers of State of New York Conservation Commission.)

RECORDS AVAILABLE.—August 5, 1915, to September 30, 1916; February 28 to September 30, 1917.

GAGE.—Chain gage near center of downstream side of bridge. Prior to March 30, 1916, inclined staff on right bank about 400 feet above bridge, at practically same datum (560.00 feet, Conservation Commission datum). Gage read by L. J. Dagon and Thomas Maimone.

DISCHARGE MEASUREMENTS.—Made from highway bridge or by wading.

CHANNEL AND CONTROL.—Creek flows through improved channel which is in gravel and is likely to shift.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 16.5 feet from 2 to 3 p. m. July 29 (discharge, 4,170 second-feet); minimum stage recorded, 6.7 feet at 6 p. m. August 20 and 8 a. m. and 6 p. m. August 26, 27 (discharge, 47 second-feet).

1915–1917: Maximum stage recorded July 29, 1917; minimum stage recorded, 6.5 feet from 6 p. m. September 21 to 6 p. m. September 22, 1916 (discharge 36 second-feet).

ICE.—Stage-discharge relation affected by ice. Observations of stage suspended during winter.

ACCURACY.—Stage-discharge relation permanent; affected by ice December to March. Rating curve well defined between 35 and 3,000 second-feet. Gage read by half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good except those for floods of several days' duration, when stage-discharge relation may be affected by backwater.

Discharge measurements of Canaseraga Creek at Groveland Station, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Mar. 29	O. W. Hartwell	9.16	432	July 13	E. D. Burchard	8.28	240
May 19	E. D. Burchard	7.16	89.3	13	.....do	8.28	234
19	.....do	7.15	90.8	Aug. 25	C. D. De Golyer	6.83	60.2
June 21	.....do	8.40	276	Sept. 20	E. D. Burchard	7.80	182
July 11	C. S. De Golyer	9.39	443	20	.....do	7.73	169

Daily discharge, in second-feet, of Canaseraga Creek at Groveland Station, N. Y., for the year ending Sept. 30, 1917.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		675	675		238	292		83
2		517	555		221	328		
3		441	460		171	274		
4		422	292		139	171		
5		365	238		139	147	78	
6			328		196	147	72	
7					1,130	238	72	
8		441			517	274	72	
9		403			403	256	72	
10		346	221		1,730	204	67	
11		1,050	212		695	655	58	
12		1,170	328		403	441	54	
13		460	274		274	274	72	
14		403	204		204	517	62	
15		328	171		109	441	62	
16		221	163		163	292	62	
17		365	139		132	221	62	
18		328	132		116	187	62	
19		221	124	89	635	292	54	
20		221	102	155	256	171	47	
21		346	124	147	274	328	54	
22		292	109	171	171	171	72	
23		384	109	238	139	132	54	
24		955	109	196	655	109	72	
25		460	89	221	346	109	54	
26		441	95	171	256	116	47	
27	3,010	517	102	274	292	147	47	50
28	955	517	95	575	365	109	50	50
29		403	83	595	310	955	78	54
30		328	83	384	238	479	204	62
31		292		346		196	109	

NOTE.—No gage-height record Oct. 1 to Feb. 26, Mar. 6, 7, Apr. 7–9, May 1–18, Aug. 1–4 and Sept. 2–26; mean discharge estimated as follows: Mar. 6 and 7, 400 second-feet; Apr. 7–9, 300 second-feet; Aug. 1–4, 110 second-feet.

Monthly discharge of Canaseraga Creek at Groveland Station, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 195 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
March	1,170	221	455	2.33	2.69
April	675	83	217	1.11	1.24
June	1,730	109	364	1.87	2.09
July	955	109	280	1.44	1.66
August	204	47	74.5	.382	.44

CANASERAGA CREEK AT SHAKERS CROSSING, N. Y.

LOCATION.—At highway bridge at Shakers Crossing, about a mile above mouth, and 1¼ miles northeast of Mount Morris, Livingston County.

DRAINAGE AREA.—347 square miles (measured by engineers of New York State Conservation Commission).

RECORDS AVAILABLE.—Occasional current-meter measurements 1904–1915: continuous record of gage height and occasional current-meter measurements July 13, 1915, to September 30, 1917.

GAGE.—Gurley seven-day water-stage recorder on the left bank, just below bridge. Datum of gage same as that established on Genesee River at Jones Bridge near Mount Morris July 12, 1915 (540.00 feet Conservation Commission datum). Recorder inspected [illegible] Russell.

Discharge measurements.—Made from the highway bridge or by wading.

Channel and control.—Firm gravel; not likely to shift; subject to backwater from Genesee River.

Ice.—Stage-discharge relation affected by ice.

Extremes of stage.—Maximum stage during year, from water-stage recorder, 25.10 feet at 4 p. m. March 12; minimum stage, from water-stage recorder, 7.95 feet at 11 p. m. October 30.

1915–1917: Maximum stage, from water-stage recorder, 28.92 feet at 1 p. m. May 17, 1916; minimum stage, from water-stage recorder, 7.95 feet at 11 p. m. October 30, 1916.

Data on extent and duration of backwater from Genesee River too meager to permit accurate determination of discharge.

Discharge measurements of Canaseraga Creek at Shakers Crossing, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 28	E. D. Burchard	7.99	47.5	July 11	C. S. DeGolyer	13.93	1,090
28	.....do	7.99	49.3	14	E. D. Burchard	11.77	966
Jan. 18[a]	.....do	9.58	223	Aug. 23	C. S. DeGolyer	9.03	227
Mar. 8[b]	O. W. Hartwell	11.22	367	Sept. 20	E. D. Burchard	9.39	379
28	.....do	14.11	913	20	.....do	9.51	405
May 21	E. D. Burchard	9.63	360				

[a] Measurement made through complete ice cover. [b] Measurement made through partial ice cover.

Daily gage height, in feet, of Canaseraga Creek at Shakers Crossing, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	8.25	8.06	9.29	8.91	10.72	17.65	13.81	9.08	10.34	....	9.52	8.94
2	8.12	8.40	9.00	9.08	10.47	14.22	14.64	8.99	10.57	12.67	9.15	9.12
3	8.22	8.73	8.67	9.01	9.94	12.44	14.02	9.02	9.74	12.84	9.10	9.78
4	8.19	8.70	8.79	9.11	9.69	11.62	11.61	8.98	9.56	....	9.09	8.98
5	8.22	8.35	8.80	9.50	9.67	11.52	10.58	9.71	9.25	....	8.75	8.88
6	8.20	8.70	8.68	15.34	9.61	11.08	11.48	10.83	9.79	....	9.09	8.91
7	8.24	8.72	8.65	12.50	9.55	11.16	12.64	11.81	17.40	....	9.09	8.89
8	8.27	8.67	8.68	10.09	9.55	11.18	11.83	10.93	16.13	10.50	9.04	9.70
9	8.15	8.66	8.69	9.58	9.60	11.37	11.19	10.15	12.48	10.50	9.05	9.41
10	8.33	8.73	8.51	9.38	9.59	11.02	10.27	10.51	12.53	9.95	9.01	9.03
11	8.26	8.86	8.63	9.17	9.62	13.55	10.04	9.92	15.91	12.57	8.94	8.89
12	8.25	8.47	8.67	9.35	9.58	23.60	10.57	9.58	12.34	11.33	8.58	8.80
13	8.27	8.70	8.63	9.38	....	22.47	10.28	9.26	10.65	10.18	8.65	8.78
14	8.60	8.89	8.65	9.41	....	17.76	9.80	9.31	9.92	11.54	9.15	8.72
15	8.69	8.92	8.89	9.49	....	14.86	9.27	9.22	9.44	13.56	9.96	8.67
16	8.74	8.87	8.91	9.48	....	11.18	9.49	9.15	9.38	10.48	9.45	8.44
17	8.71	8.80	8.50	9.46	9.69	11.79	9.41	9.13	9.18	9.72	8.80	8.68
18	8.62	8.81	8.73	9.47	9.94	12.71	9.32	9.10	9.25	9.85	8.78	8.65
19	8.56	8.55	8.80	9.48	10.17	10.50	9.33	9.10	11.66	10.04	8.75	8.69
20	8.88	8.72	8.78	9.55	10.29	10.14	9.31	9.15	10.26	9.66	8.75	9.33
21	9.04	8.84	8.73	9.49	10.10	12.05	9.24	9.48	10.13	9.59	8.48	9.06
22	8.83	8.78	8.80	9.54	10.09	11.52	8.85	9.60	9.54	9.72	8.91	8.84
23	8.43	8.75	8.88	9.66	10.10	12.93	9.11	10.00	9.27	9.72	8.85	8.75
24	8.06	9.05	8.57	9.70	10.23	17.82	9.19	9.92	12.50	9.10	8.91	8.71
25	8.03	9.24	8.57	9.70	10.48	15.82	9.08	10.10	11.30	9.20	8.80	8.66
26	8.01	8.76	8.84	9.55	11.34	13.33	9.11	9.66	10.50	9.00	8.74	8.63
27	8.01	8.96	8.88	9.44	17.88	13.50	9.08	9.35	13.52	9.20	8.72	8.55
28	8.00	8.96	9.00	9.39	21.11	14.41	9.05	11.22	....	9.02	8.70	8.59
29	8.00	9.45	9.40	9.44	....	12.83	8.51	13.80	....	11.52	8.84	8.60
30	7.98	10.08	9.27	9.73	....	12.05	9.04	12.36	....	15.38	9.08	8.50
31	8.00	....	8.80	10.20	....	11.21	....	10.72	....	10.15	9.12	.....

Note.—Intake to float well stopped by silt June 28 to July 1, July 4–10, and July 31 to August 22. Gage heights for following periods are mean of two observations per day on staff gage: July 8–10 and July 31 to Aug. 22.

KESHEQUA CREEK NEAR SONYEA, N. Y.

Location.—About 400 feet above Delaware, Lackawanna & Western Railroad bridge and half a mile below gaging station formerly maintained at Sonyea, Livingston County.

Drainage area.—74 square miles (measured on topographic maps).

Records available.—August 29, 1915, to October 31, 1917, when station was discontinued. July 22, 1910, to December 31, 1912, at former station at Sonyea.

Gage.—Staff, in two sections; inclined section graduated from 3.0 to 6.0 feet; vertical section graduated from 6.0 to 17.0 feet; read by Fred Mott and Mrs. Rose Feathers.

Discharge measurements.—Made from footbridge at gage or by wading.

Channel and control.—Gravel, probably fairly permanent.

Extremes of discharge.—1915–1917: Maximum stage recorded, 13.15 feet at 7 a. m. March 28, 1916 (discharge not determined); minimum stage recorded, 3.8 feet several times during October, 1916 (discharge practically zero).

Ice.—Stage-discharge relation affected by ice. Observations of stage suspended during winter.

Accuracy.—Stage-discharge relation probably permanent; affected by ice during large part of the period December to March. Rating curve well defined between 1 and 350 second-feet and fairly well defined between 350 and 1,300 second-feet. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records fair.

Discharge measurements of Keshequa Creek near Sonyea, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 18[a]	E. D. Burchard	4.69	14.2	May 25	E. D. Burchard	4.95	61.6
Mar. 9	O. W. Hartwell	4.89	65.8	June 21	....do	4.80	53.0
30	....do	5.15	90.4	21	....do	4.79	51.8
30	....do	5.12	88.7	Aug. 1	C. C. Covert	4.26	11.5
May 25	E. D. Burchard	4.95	62.2	24	C. S. DeGolyer	4.12	5.72

[a] Measurement made through complete ice cover.

Daily discharge, in second-feet, of Keshequa Creek near Sonyea, N. Y., for the periods Oct. 1 to Dec. 31, 1916, and Aug. 1 to Oct. 31, 1917.

Day.	Oct.	Nov.	Dec.	Aug.	Sept.	Oct.	Day.	Oct.	Nov.	Dec.	Aug.	Sept.	Oct.
1	3.0	1.5	8.7	22	14	9.3	16	0	4.5	10	14	12	47
2	1.5	1.5	14	21	19	15	17	0	3.9	14	10	10	27
3	1.5	1.5	14	16	37	12	18	0	3.0	12	10	9.3	23
4	1.5	1.5	14	12	19	19	19	0	5.3	8.7	10	14	65
5	1.5	3.0	15	19	16	35	20	.2	4.5	10	10	30	164
6	0	4.5	15	12	18	30	21	0	5.3	8.7	11	19	71
7	0	5.3	15	16	27	24	22	.8	4.5	8.7	10	16	45
8	0	4.5	15	9.3	99	26	23	1.5	4.5	12	10	12	78
9	0	5.3	15	9.3	49	44	24	1.5	5.3	14	5.3	10	369
10	0	4.5	15	10	21	22	25	1.5	7.9	16	8.7	9.3	714
11	0	4.5	14	12	19	23	26	1.5	10	16	7.0	7.0	329
12	0	6.6	15	15	16	26	27	1.5	10	16	5.3	8.7	349
13	0	4.5	15	14	16	34	28	1.5	8.7	21	4.9	9.3	290
14	.8	5.3	12	21	10	22	29	3.0	10	30	8.7	8.7	851
15	0	4.5	10	10	12	44	30	1.5	12	30	19	9.3	538
							31	1.5	......	28	23	......	181

Note.—No record Apr. 1 to June 30, owing to unreliable gage readings.

Monthly discharge of Keshequa Creek near Sonyea, N. Y., for the periods Oct. 1 to Dec. 31, 1916, and Aug. 1 to Oct. 31, 1917.

[Drainage area, 74 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1916.					
October	3.0	0	0.832	0.011	0.013
November	12	1.5	5.26	.071	.079
December	30	8.7	14.9	.201	.232
1917.					
August	23	4.9	12.4	.168	.19
September	99	7.0	19.2	.259	.29
October	851	9.3	146	1.97	2.27

CANADICE LAKE OUTLET NEAR HEMLOCK, N. Y.

Location.—At foot of Canadice Lake, Livingston County. Outlet flows into Genesee River through Canadice Lake Outlet and Honeoye Creek.

Drainage area.—12.6 square miles, of which 1.0 square mile is lake surface.

Records available.—April, 1903, to September 30, 1917.

Gage.—Hook, in channel above weir.

Channel and control.—Outflow is measured over a standard thin-edged weir witn a 5-foot crest and two end contractions so arranged with needle timbers at the ends that the length may be increased to 14.96 feet. No end contractions during high water. The weir crest stands 3.14 feet above the stream channel, which is artificial with a plank bottom and vertical sides, and the crest is never submerged by back-water. Two additional rectangular gates, each one foot square with three complete contractions and a fourth incomplete contraction at the bottom.

Ice.—Stage-discharge relation not affected by ice as the pool above the weir is free from ice throughout the winter.

Diversions.—No water is diverted from Canadice Lake above the station.

Regulation.—Outflow of lake is regulated by bulkhead and gates at dam above weir.

Accuracy.—Stage-discharge relation permanent. Rating curve used is expressed by Francis formula. Corrections are made for velocity of approach for high stages. Gage read to hundredths once daily. Records good.

Cooperation.—Data collected, computed, and furnished for publication by the city engineer of Rochester.

Monthly discharge of Canadice Lake Outlet near Hemlock, N. Y., for the year ending Sept. 30, 1917.

Month.	Mean discharge.	Mean elevation of lake above low water mark.	Month.	Mean discharge.	Mean elevation of lake above low-water mark.
	Sec.-feet.	*Feet.*		*Sec.-feet.*	*Feet.*
October	0.096	1.328	May	13.170	2.211
November	2.085	1.269	June	20.156	2.287
December	3.634	.946	July	22.756	2.608
January	3.684	.965	August	4.197	2.135
February	3.934	1.032	September	3.320	1.788
March	16.289	2.144			
April	25.572	2.028	The year	9.908	1.728

Note.—Terminal water surface for year was 0.25 foot higher than that for the previous year, corresponding to a gain in storage of 7,508,350 cubic feet, or a discharge of 0.238 second-feet for the year. This correction applied to the above mean for the year gives 10.146 second-feet.

OWASCO LAKE OUTLET NEAR AUBURN, N. Y.

Location.—On the farm of Charles H. Pearce, 2 miles below center of Auburn, Cayuga County, and 3¾ miles below State dam at outlet of Owasco Lake.

Drainage area.—206 square miles (measured on topographic maps).

Records available.—November 17, 1912, to September 30, 1917.

Gage.—Gurley water-stage recorder in a concrete shelter on left bank, on the farm of Charles H. Pearce. Recorder inspected by Charles H. Pearce.

Discharge measurements.—Made by wading directly opposite the gage, or from a cable at same section.

Channel and control.—A low concrete control has been constructed about 15 feet below the gage. Crest of control is 1 foot wide and the slopes of both upstream and downstream faces are ½: 1. A small horizontal apron built on a level with the bed of the stream extends down stream 2½ feet from toe of dam. Mean elevation of the left end of the dam for a distance of 50 feet is gage height 1.28 feet; the remaining 50 feet of the crest of the dam is at a gage height 2.13 feet.

Extremes of discharge.—Maximum stage during year, from water-stage recorder, 3.47 feet from 8.15 to 8.30 a. m. June 30 (discharge, 1,070 second-feet); minimum stage not recorded.

1912-1917: Maximum stage, 6.4 feet during period March 25-30, 1913, determined by leveling from flood marks (discharge, 2,750 second-feet); minimum stage, from water-stage recorder, 1.41 feet at 1 a. m. October 15, 1915 (discharge, 5.6 second-feet).

Ice.—Stage-discharge relation seldom affected by ice.

Diversions.—An average flow of about 10 second-feet is pumped from Owasco Lake for the municipal water supply of the city of Auburn. Proportion returning to stream above the gaging station is not known.

Regulation.—Large diurnal fluctuation in flow during low-water periods due to operation of mills in the city of Auburn; seasonal flow regulated at the State dam.

Accuracy.—Stage-discharge relation permanent; not affected by ice during year. Rating curve well defined between 1 and 1,700 second-feet. Operation of the water-stage recorder satisfactory throughout year, except during periods indicated in footnote to daily-discharge table. Daily discharge ascertained by averaging the hourly discharge. Records excellent except for periods of no gage-height records and when there was leakage under control. See footnote to daily-discharge table.

Discharge measurements of Owasco Lake outlet near Auburn, N. Y., during the year ending Sept. 30, 1917.

[Made by E. D. Burchard.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Nov. 9	2.16	173	Nov. 9	2.12	159	Feb. 5	2.34	221
Nov. 9	1.69	67.2	Nov. 13	2.18	156	May 15	2.63	359
Nov. 9	2.00	138						

Daily discharge, in second-feet, of Owasco Lake outlet near Auburn, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	38.0	95.7	96.5	104	......	163	758	339	448	926	......	278
2	103	89.7	90.1	112	......	158	776	324	434	919	......	248
3	96.0	88.8	55.0	109	......	152	787	307	402	899	......	241
4	100	102	106	92.2	......	181	830	303	401	854	......	255
5	98.8	10.0	98.8	119	......	177	814	313	407	825	......	242
6	99.1	61.8	96.5	116	175	178	836	323	406	698	......	234
7	80.1	67.0	93.0	89.4	173	158	836	342	447	599	......	230
8	57.0	70.8	87.9	116	161	172	824	366	551	579	......	245
9	103	69.3	82.5	119	165	......	811	404	745	573	......	245
10	85.8	82.1	56.7	118	158	......	807	397	760	562	......	247
11	91.6	91.0	108	130	......	......	789	374	855	506	......	241
12	92.5	24.9	98.2	120	......	......	761	360	908	493	......	236
13	......	112	93.3	130	......	......	730	334	859	495	......	228
14	......	87.1	97.9	120	......	......	723	351	805	394	176	221
15	......	83.6	102	147	......	......	685	335	......	273	197	217
16	......	90.3	87.7	......	......	......	686	341	......	286	194	189
17	......	82.9	75.1	......	......	275	704	......	......	346	214	212
18	......	75.3	113	......	......	270	671	......	......	425	222	203
19	......	56.1	107	......	......	282	644	......	......	419	211	207
20	......	97.4	102	......	160	291	634	......	......	418	242	207
21	......	88.5	103	......	164	317	591	......	......	397	235	198
22	......	87.3	109	......	171	364	545	......	......	357	236	180
23	......	83.3	97.0	......	166	444	454	......	677	320	232	182
24	......	82.6	69.3	......	162	543	355	......	663	305	223	197
25	......	71.5	84.7	......	209	633	294	......	658	262	236	185
26	......	59.2	117	......	184	704	350	340	726	234	188	181
27	......	96.3	108	......	169	738	348	318	914	232	229	177
28	......	85.2	101	......	160	791	388	342	918	222	211	176
29	......	122	114	......	......	807	380	377	939	220	221	186
30	......	68.4	91.5	......	......	755	356	399	941	237	253	174
31	92.4	......	75.4	......	......	771	......	432	......	260	270	......

NOTE.—During November a leak was discovered under the control, discharging between 20 and 25 second-feet. This was assumed to have started October 12. The leak was repaired November 5. Daily discharge Oct. 31 to Nov. 4 includes this leakage. Mean discharge estimated for following periods because recorder was not in operation: Oct. 13-30, 82.0 second-feet; Jan. 16-31, 135 second feet; Feb. 1-5, 155 second-feet; Feb. 11-19, 160 second-feet; March 9-16, 220 second-feet; May 17-25, 340 second-feet; June 15-22, 740 second-feet; Aug. 1-13, 230 second-feet. Discharge, July 31 and Aug. 31, estimated.

Monthly discharge of Owasco Lake outlet near Auburn, N. Y., for the year ending Sept. 30, 1917.

[Drainage area 206 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	103	....	84.4	0.410	0.47
November	122	a10.0	79.4	.385	.43
December	117	b55.0	94.2	.457	.53
January	....	b89.4	126	.612	.71
February	209	....	164	.796	.83
March	807	152	358	1.74	2.01
April	836	294	639	3.10	3.46
May	432	303	348	1.69	1.95
June	941	401	693	3.36	3.75
July	926	b220	469	2.28	2.63
August	....	176	225	1.09	1.26
September	278	b174	215	1.04	1.16
The year	941	10.0	291	1.41	19.19

a Estimated. b Sunday.

WEST BRANCH OF ONONDAGA CREEK AT SOUTH ONONDAGA, N. Y.

Location.—At highway bridge in South Onondaga, Onondaga County, about 1½ miles above mouth of creek and about 10 miles above Syracuse.

Drainage area.—20.8 square miles (measured on topographic maps).

Records available.—August 22, 1916, to September 30, 1917.

Gage.—Staff on downstream side of right abutment of bridge.

Discharge measurements.—Made from bridge or by wading.

Channel and control.—Fine and coarse gravel; probably shifting.

Extremes of stage.—Maximum stage recorded, 2.86 feet at 7.05 a. m. March 12; minimum stage recorded, 0.90 foot at 6.45 p. m. September 24 and 6.35 a. m. September 25.

Ice.—Stage-discharge relation probably affected by ice.

Data inadequate for determination of discharge.

Discharge measurements of West Branch of Onondaga Creek at South Onondaga, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 30	E. D. Burchard........	1.22	9.58	May 15	E. D. Burchard........	1.27	20.6
30	.....do..................	1.20	8.83	June 13	O. W. Hartwell........	1.36	24.6

Daily gage height, in feet, of West Branch of Onondaga Creek at South Onondaga, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.13	1.36	1.27	....	1.92	1.36	1.37	1.54	1.01	1.06
2	1.11	1.23	1.24	....	2.0	1.34	1.33	1.56	1.01	1.03
3	1.1	1.2	1.21	....	2.01	1.30	1.30	1.38	1.00	1.01
4	1.06	1.16	1.24	....	1.77	1.27	1.28	1.33	1.00	.98
5	1.08	1.36	1.34	....	1.59	1.53	1.30	1.27	1.00	.97
6	1.04	1.27	1.28	....	1.75	1.69	1.38	1.23	.99	1.02
7	1.04	1.19	1.22	1.4	1.91	1.54	2.06	1.21	.99	.99
8	1.04	1.18	1.23	1.39	1.71	1.44	2.07	1.19	.97	1.02
9	1.05	1.21	1.24	1.4	1.60	1.39	1.65	1.23	1.04	.98
10	1.08	1.29	1.32	1.41	1.52	1.33	1.51	1.31	1.03	1.04
11	1.03	1.22	1.3	2.3	1.49	1.33	1.52	1.29	1.01	.98
12	1.03	1.17	1.29	2.66	1.49	1.49	1.42	1.26	.98	.98
13	1.13	1.17	1.23	2.07	1.47	1.34	1.33	1.32	.95	.97
14	1.28	1.20	1.2	1.83	1.43	1.29	1.29	1.33	1.18	.95
15	1.15	1.25	1.19	1.68	1.42	1.26	1.28	1.48	1.06	.95
16	1.09	1.18	1.12	1.64	1.42	1.25	1.41	1.45	.99	.95
17	1.13	1.19	1.14	1.87	1.39	1.28	1.29	1.27	1.01	1.02
18	1.09	1.25	1.23	1.78	1.37	1.24	1.25	1.22	.98	1.01
19	1.15	1.25	1.22	1.59	1.39	1.21	1.26	1.21	.97	.95
20	1.17	1.29	1.19	1.69	1.54	1.54	1.36	1.16	.95	.99
21	1.36	1.26	1.2	1.87	1.47	1.37	1.33	1.16	.99	.95
22	1.19	1.17	1.18	1.89	1.36	1.44	1.22	1.14	.97	.94
23	1.15	1.34	1.22	2.14	1.34	1.44	1.16	1.12	.95	.94
24	1.10	1.45	1.28	2.59	1.34	1.37	1.39	1.09	1.04	.92
25	1.15	1.29	1.26	2.09	1.29	1.34	1.42	1.08	.98	.91
26	1.19	1.19	1.25	2.13	1.32	1.28	1.87	1.06	.96	.93
27	1.11	1.19	1.31	2.13	1.38	1.3	2.37	1.07	.97	.97
28	1.16	1.23	1.44	2.14	1.31	1.32	1.64	1.12	.95	1.03
29	1.09	1.22	1.36	2.09	1.27	1.81	1.68	1.10	1.12	1.01
30	1.16	1.31	1.24	1.85	1.38	1.59	1.55	1.07	1.05	1.10
31	1.10	....	1.21	1.75	....	1.38	....	1.03	1.01	....

Note.—Observations suspended because of ice, Jan. 1 to Mar. 6.

BLACK RIVER NEAR BOONVILLE, N. Y.

Location.—At highway bridge about 1 mile above mouth of Sugar River, 2 miles northeast of Boonville, Oneida County, and 2 miles, by river, downstream from Hawkinsville.

Drainage area.—303 square miles (measured on topographic maps).

Records available.—February 16, 1911, to September 30, 1917.

Gage.—Chain near center of left span, downstream side of bridge; staff gage on right abutment used for high-water readings; read by W. D. Charbonneau.

Discharge measurements.—Made from a cable about half a mile above gage or by wading near the cable.

Channel and control.—Rough and full of boulders; permanent.

Extremes of discharge.—Maximum stage recorded during year, 9.8 feet at 4 p. m. June 12 (discharge, 5,240 second-feet); minimum stage recorded 3.02 feet at 4 p. m. August 5 (discharge 28 second-feet).

1911–1917: Maximum stage (determined by leveling from flood mark) about 12.5 feet during night of March 28, 1913 (discharge, about 10,000 second-feet); minimum stage recorded, 3 feet at 8 a. m. September 29 and November 8, 1913, and October 8, 1914 (discharge, 27 second-feet).

Ice.—Stage-discharge relation affected by ice.

Regulation and diversion.—The State dam at Forestport, about 8 miles upstream, provides a reservoir with a capacity of about 2,000,000,000 cubic feet. Water is diverted from this reservoir during the navigation season through the Forestport Feeder, flowing west to a basin in Boonville. The Black River canal flows north from this basin entering Black River at the foot of Lyons Falls. A spillway from the basin overflows into Mill Creek, a tributary of Black River. Water flowing through these two channels returns to the river below the gaging station, thus passing around it. The Black River canal also flows south from Boonville, passing out of the Black River drainage and entering the summit level of the Erie canal (or Barge canal) at Rome.

Occasional discharge measurements have been made at three points to indicate the distribution of the diverted water. The water entering Boonville through the Forestport Feeder has been measured at the highway bridge about 1 mile northeast of Boonville. During October, 1915, two water-stage recorders were installed on this canal to obtain a continuous record of flow, which is published as a separate station "Forestport Feeder near Boonville, N. Y." The water flowing north from the basin through the Black River canal has been measured at the highway bridge just below the lock into this canal near the railroad station. The water flowing south from the basin has been measured at a private farm bridge about 1 mile southeast of Boonville. During September, 1915, two water-stage recorders were installed on this canal to obtain a continuous record of the flow, which is published as a separate station, "Black River canal (flowing south) near Boonville, N. Y."

Accuracy.—Stage-discharge relation practically permanent; affected by ice during a large part of the period December to March, inclusive. Rating curve well defined between 35 and 2,800 second-feet and fairly well defined between 2,800 and 4,500 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good, except for periods when the stage-discharge relation was affected by ice, for which they are fair.

Discharge measurements of Black River near Boonville, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 11[a]	A. H. Davison	5.37	344	Mar. 9[b]	A. H. Davison	5.65	390
Feb. 10[b]	.....do	5.24	301	June 4	O. W. Hartwell	5.35	565

[a] Measurement made through incomplete ice cover.
[b] Measurement made through complete ice cover.

Daily discharge, in second-feet, of Black River near Boonville, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	335	194	2,740	300	600	500	3,620	855	855	1,290	56	680
2	352	335	2,380	280	550	700	3,880	920	580	1,460	52	450
3	305	490	1,460	260	550	750	4,010	990	605	1,140	49	370
4	262	580	1,060	280	480	600	3,490	1,210	580	855	40	238
5	205	535	1,140	300	420	500	2,740	1,290	680	630	31	184
6	194	335	1,370	380	400	460	2,740	1,140	1,210	490	33	184
7	145	194	1,460	380	380	460	2,860	1,210	1,840	370	36	174
8	111	164	1,290	320	360	480	2,620	990	2,380	335	63	205
9	97	136	1,210	380	320	380	2,500	920	2,860	205	145	174
10	78	184	1,140	440	300	400	2,160	1,060	3,490	154	205	111
11	90	194	990	340	300	600	1,370	1,210	4,140	250	216	90
12	111	184	795	320	280	700	920	1,290	5,100	680	127	84
13	127	194	735	550	260	800	735	1,060	4,960	490	111	56
14	164	216	605	850	240	700	680	920	4,540	470	104	59
15	184	194	535	1,200	220	750	605	920	4,010	390	84	70
16	216	184	500	1,000	240	750	630	795	2,620	450	72	97
17	227	194	460	950	200	600	795	735	1,460	305	97	90
18	194	205	440	900	190	550	1,060	680	855	174	111	63
19	250	127	420	850	180	420	1,370	630	535	111	119	56
20	490	66	400	750	170	280	2,500	605	535	66	111	49
21	680	72	340	750	170	300	3,880	580	735	119	97	90
22	735	90	360	850	170	380	4,410	680	990	164	119	111
23	605	194	420	800	170	500	4,010	920	795	127	490	127
24	410	920	360	800	150	950	3,620	605	680	97	2,980	97
25	305	1,040	320	800	140	1,800	3,360	1,940	630	90	2,380	84
26	305	855	300	800	190	1,900	4,010	2,380	795	66	795	78
27	275	450	300	800	500	1,800	4,010	2,620	450	59	335	59
28	238	227	260	750	700	1,800	2,980	2,270	580	72	250	84
29	205	490	260	700	....	1,840	2,050	2,050	735	68	390	53
30	184	1,740	300	650	....	2,160	1,210	1,940	990	70	630	63
31	205	....	260	650	....	2,860	....	1,540	....	53	855	....

NOTE.—Discharge, Dec. 16 to Mar. 28 estimated, because of ice, from discharge measurements, weather records, and study of gage-height graph.

Monthly discharge of Black River near Boonville, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 303 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	735	78	267	0.882	1.02
November	1,740	66	366	1.21	1.35
December	2,740	260	794	2.62	3.02
January	1,200	260	625	2.06	2.38
February	700	140	315	1.04	1.08
March	2,860	280	893	2.95	3.40
April	4,410	605	2,490	8.22	9.17
May	2,620	580	1,190	3.93	4.53
June	5,100	450	1,710	5.64	6.29
July	1,460	53	365	1.20	1.38
August	2,980	31	361	1.19	1.37
September	680	49	144	.475	.53
The year	5,100	31	793	2.62	35.52

NOTE.—Water diverted past this station by the Forestport feeder is not included in the above table.

BLACK RIVER AT BLACK RIVER, N. Y.

LOCATION.—About one-fourth mile below concrete-arch highway bridge and power plant of Northern New York Utilities Co. and three-fourths mile below village of Black River, Jefferson County.

DRAINAGE AREA.—1,870 square miles (measured on topographic maps).

RECORDS AVAILABLE.—March 24 to September 30, 1917.

GAGE.—Vertical staff, in two sections, spiked to large cedar tree on left bank about one-fourth mile below highway bridge; read by Erwin W. Hart.

DISCHARGE MEASUREMENTS.—Made from cable about 100 yards above gage.

CHANNEL AND CONTROL.—Solid rock.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period of record, 13.4 feet from 6 p. m. April 4 to 7 a. m. April 5 (discharge, 19,300 second-feet); minimum stage recorded, 1.05 feet at 2.45 p. m. July 29, when a current-meter measurement was made (discharge, about 16 second-feet).

ICE.—Stage-discharge relation probably not affected by ice.

REGULATION.—Seasonal distribution of flow is regulated by Beaver River flow, Fulton Chain lakes, Forestport reservoir and other storage reservoirs in the upper portion of the drainage basin. Some diurnal fluctuation at low stages due to mills and power plants above station.

DIVERSIONS.—Water is diverted from Black River into Forestport Feeder at Forestport. A portion of this water returns to river through various spillways and through Black River canal (flowing north). The remainder passes out of the drainage basin through Black River canal (flowing south); the record at the station on Black River canal (flowing south) at Boonville indicates the amount of this diversion. See also "Regulation and Diversion" in description of station on Black River near Boonville.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 500 and 18,000 second-feet. Gage read to tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good except for days of low discharge, for which they may be poor.

Discharge measurements of Black River at Black River, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 1	A. H. Davison	10.78	12,600	July 28	E. D. Burchard	3.87	1,150
1	.....do	10.83	12,800	29	.....do	3.73	1,060
6	.....do	12.66	17,300	29	.....do	3.72	1,060
7	.....do	12.21	16,400	29	.....do	3.25	711
7	.....do	11.96	15,300	29	.....do	3.11	625
11	.....do	9.16	9,090	29	.....do	1.18	25.6
June 7	O. W. Hartwell	5.83	3,460	Sept. 30	.....do	3.33	794
July 14	C. C. Covert	5.58	3,050	30	.....do	3.51	857
28	E. D. Burchard	3.88	1,150				

Daily discharge, in second-feet, of Black River at Black River, N. Y., for the year ending Sept. 30, 1917.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		12,600	7,990	6,700	4,550	1,370	2,240
2		14,600	7,610	6,180	5,030	1,180	2,360
3		17,300	8,180	5,350	4,710	1,180	2,800
4		19,300	8,570	5,190	3,250	1,180	3,250
5		19,000	8,370	4,250	3,250	1,020	2,600
6		17,600	7,990	3,670	2,990	1,020	2,120
7		15,800	7,010	3,530	2,730	880	1,680
8		13,800	6,880	4,250	2,500	778	1,680
9		12,000	6,180	5,510	2,250	1,020	1,370
10		9,990	5,510	6,180	2,200	1,270	1,370
11		9,170	5,350	7,610	2,360	1,680	1,470
12		8,180	5,510	8,570	2,860	1,790	1,470
13		7,210	5,670	9,170	3,530	1,680	1,100
14		6,700	5,840	11,500	3,120	845	845
15		6,010	5,350	11,500	2,240	880	950
16		5,190	4,870	9,990	2,240	950	797
17		5,030	4,870	8,180	2,120	2,120	1,370
18		5,030	4,250	7,060	1,900	1,680	880
19		6,180	3,950	6,010	1,790	1,470	1,370
20		6,880	3,530	4,710	1,270	1,470	1,270
21		9,780	3,670	4,100	1,470	1,680	1,180
22		12,600	4,100	4,400	1,680	2,240	1,270
23		16,000	4,250	4,710	1,680	2,120	1,270
24		15,800	4,870	4,250	1,370	2,600	1,270
25	8,370	14,600	5,510	3,530	1,470	3,120	620
26	10,600	13,400	5,840	3,530	1,680	3,670	1,270
27	13,800	11,500	5,840	3,120	1,470	2,730	1,100
28	17,300	10,400	5,670	3,120	1,270	2,360	1,180
29	18,100	9,370	5,670	2,800	880	2,010	1,100
30	16,000	8,570	5,070	3,670	1,180	1,900	745
31	14,100		6,520		1,180	2,240	

NOTE.—Daily discharge estimated Apr. 8–10.

Monthly discharge of Black River at Black River, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 1,870 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
April	19,300	5,030	10,400	5.56	6.20
May	8,570	3,530	5,860	3.13	3.61
June	11,500	2,800	5,750	3.07	3.42
July	5,030	880	2,330	1.25	1.44
August	3,670	778	1,680	.898	1.04
September	3,250	620	1,470	.786	.88

NOTE.—See "Regulation" and "Diversion" in station description.

FORESTPORT FEEDER NEAR BOONVILLE, N. Y.

Location.—Slope station at lower end of feeder, above point where it enters the basin at Boonville, Oneida County.

Records available.—Occasional discharge measurements 1900 and 1905–1915; continuous record October 30, 1915, to September 30, 1917. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

Gages.—Two Gurley seven-day water-stage recorders, with natural scale for gage heights. Gage No. 1 is at downstream end of left abutment of steel highway bridge in village of Hawkinsville; gage No. 2 is on left bank, just below a farm bridge about a mile above the basin at Boonville; they are 2.53 miles apart. The float wells are 1½ by 2 feet, inside dimensions, and the bottoms are about 1½ feet below normal elevation of water surface in canal. These gages and the two in the Black River canal (flowing south) near Boonville are all set at the same datum; recorder at gage No. 1 inspected by Mrs. Anna Zwahlen; that at gage No. 2 inspected by Charles Nugent.

Discharge measurements.—Made from the steel highway bridge at gage No. 1 in Hawkinsville.

Determination of discharge.—Daily discharge determined by use of Chezy formula. The coefficient, "C," is computed from each current-meter measurement and is plotted on a curve showing the variation of "C" through the season. A smooth curve drawn through the plotted points shows the coefficients for intervening days. The other factors in the Chezy formula are obtained from gage-height records and cross-section of the canal.

Diversions.—One spillway takes water from the Forestport feeder just below gage No. 2 and a second spillway takes water from the basin in Boonville. Both discharge into Mill Creek, which enters Black River below the Boonville gaging station. No spillway between gage No. 1 and gage No. 2. Other spillways in the feeder above gage No. 1 discharge into Black River above the gaging station. Therefore, this station indicates the total amount of water diverted past the gaging station on Black River near Boonville, and the sum of this record and the record for the Black River near Boonville indicates the total run-off of the Black River basin above these gaging stations.

Regulation.—Flow in the feeder is regulated at the outlet of Forestport reservoir.

Ice.—No flow in the canal during the winter season.

Accuracy.—Records good except for days on which discharge varies widely from the mean, for which they are fair.

Discharge measurements of Forestport feeder near Boonville, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height in feet. Gage No. 1.	Gage No. 2.	Discharge.	Date.	Made by—	Gage height in feet. Gage No. 1.	Gage No. 2.	Discharge.
				Sec.-ft.					Sec.-ft.
Oct. 12	A. H. Davison	3.321	1.952	262	July 13	C. C. Covert	3.19	1.842	273
31	E. D. Burchard	3.556	2.146	288	27	E. D. Burchard	2.998	1.742	225
31	d	3.547	2.138	291	27	do	3.016	1.746	225
31	do	3.532	2.142	290	Aug. 15	do	3.280	1.848	252
31	do	3.528	2.130	289	15	do	3.280	1.844	251
Nov. 24	A. H. Davison	3.325	1.885	278	Sept. 3	C. C. Covert	2.90	1.56	205
June 2	O. W. Hartwell	2.47		189	26	E. D. Burchard	3.045	1.774	216
4	do	2.49	1.49	185	26	do	3.038	1.766	219
12	do	2.40	1.14	195					

Daily discharge, in second-feet, of Forestport feeder near Boonville, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	June.	July.	Aug.	Sept.
1	237	293	150	265	233	225
2	232	300	189	257	245	218
3	258	303	210	260	234	227
4	245	297	193	296	228	254
5	247	291	273	289	217	246
6	250	291	287	300	212	221
7	253	286	297	294	224	221
8	255	290	330	280	231	233
9	251	287	314	280	248	226
10	255	299	302	287	238	233
11	252	300	320	209	230	241
12	253	305	195	207	231	238
13	262	311	261	254	245	230
14	245	......	286	278	246	217
15	232	......	276	280	243	229
16	231	......	263	276	252	227
17	238	......	258	276	250	220
18	248	......	251	271	233	226
19	257	......	306	261	228	238
20	248	......	308	255	227	235
21	229	......	278	246	233	235
22	248	......	293	241	254	237
23	244	......	285	245	230	235
24	256	......	276	247	265	243
25	256	......	276	256	229	231
26	259	......	282	245	239	222
27	234	......	282	244	217	231
28	275	......	277	266	208	245
29	277	......	295	241	227	242
30	277	......	295	240	220	252
31	291	......	......	244	214	......

NOTE.—Discharge, Nov. 14–30, estimated at 284 second-feet. Feeder dry from December to May.

Monthly discharge, in second-feet, of Forestport feeder, near Boonville, N. Y., for the year ending Sept. 30, 1917.

Month.	Maximum.	Minimum.	Mean.
October	291	229	251
November	311	....	289
December	0	0	0
January	0	0	0
February	0	0	0
March	0	0	0
April	0	0	0
May	0	0	0
June	330	[a] 150	270
July	300	207	263
August	265	212	233
September	254	217	233
The year	330	0	129

[a] Estimated.

BLACK RIVER CANAL (FLOWING SOUTH) NEAR BOONVILLE, N. Y.

LOCATION.—Slope station in summit level of Black River canal, near Boonville, Oneida County.

RECORDS AVAILABLE.—Occasional discharge measurements 1900 and 1905–1915; continuous record September 16, 1915, to September 30, 1917.

GAGES.—Two Gurley seven-day water-stage recorders with natural scale for gage heights; they are 1.81 miles apart. Gage No. 1 is on right bank (opposite towpath) about 50 feet downstream from collector's office in Boonville; gage No. 2 is on right bank (opposite towpath) about 300 yards above Lock 70 and 50 yards above spillway from the canal into Lansing Kill. These gages and the two gages in the Forestport feeder near Boonville are set to the same datum. Recorders inspected by Philip Joynt.

DISCHARGE MEASUREMENTS.—Made from the steel and concrete highway bridge in the village of Boonville, a short distance below gage No. 1.

Determination of discharge.—Daily discharge determined by use of Chezy formula. The coefficient "C" is computed from each current-meter measurement and plotted on a curve showing the variation of "C" through the season. A smooth curve drawn through the plotted points shows the coefficient for intervening days. The other factors in the Chezy formula are obtained from gage-height records and cross-section of canal.

Diversions.—No diversions between gage No. 1 and gage No. 2. Records obtained at this station indicate the quantity of water diverted for the canal from the Black River basin into the Mohawk River basin.

Regulation.—Flow in canal is regulated by operation of spillway and sluice gates at Lock 70 and also by discharge of Forestport feeder into the basin at Boonville.

Ice.—No flow in canal during winter season.

Accuracy.—Records good.

Discharge measurements of Black River canal (flowing south) near Boonville, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height in feet. Gage No. 1.	Gage No. 2.	Discharge.	Date.	Made by—	Gage height in feet. Gage No. 1.	Gage No. 2.	Discharge.
				Sec.-ft.					Sec.-ft.
Oct. 13	A. H. Davison	1.630	1.135	198	July 13	C. C. Covert	1.52	....	190
31	E. D. Burchard	1.640	1.090	251	26	E. D. Burchard	1.491	1.126	180
Nov. 1	.....do	1.680	1.162	257	27	.....do	1.434	1.074	181
1	.....do	1.689	1.712	254	27	.....do	1.438	1.978	178
1	.....do	1.708	1.168	254	Aug. 15	.....do	1.432	.930	180
1	.....do	1.700	1.160	254	15	.....do	1.440	.940	176
23	A. H. Davison	1.240	.930	149	15	.....do	1.428	.940	182
June 2	O. W. Hartwell	1.100	....	157	Sept. 3	C. C. Covert	1.181	.545	145
5	.....do	1.600	1.265	245	25	E. D. Burchard	1.571	1.110	172
12	.....do	.840	.670	140	25	.....do	1.559	1.106	174

Daily discharge, in second-feet, of Black River canal (flowing south) near Boonville, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	June.	July.	Aug.	Sept.	Day.	Oct.	Nov.	June.	July.	Aug.	Sept.
1	190	251	130	197	181	151	16	192	......	......	192	183	162
2	185	253	157	176	173	173	17	188	......	......	186	185	164
3	208	254	170	185	178	175	18	200	......	......	177	181	168
4	202	249	145	184	180	172	19	226	......	......	178	172	171
5	207	241	211	196	177	161	20	225	......	......	180	176	169
6	206	244	207	191	178	163	21	200	......	......	181	179	172
7	198	244	229	183	178	165	22	213	......	......	179	177	170
8	207	241	245	195	176	168	23	215	......	177	175	172	171
9	202	244	236	186	186	169	24	215	......	174	182	173	175
10	205	263	220	194	178	166	25	222	......	177	183	171	166
11	204	244	244	180	174	173	26	228	......	188	182	165	175
12	197	248	140	154	176	167	27	212	......	184	174	143	172
13	209	255	......	190	182	169	28	236	......	183	189	141	174
14	191	262	......	189	187	162	29	243	......	181	175	165	174
15	191	......	......	193	180	168	30	234	......	180	169	164	181
							31	250	......	......	176	146	......

Note.—Discharge Nov. 15-30 estimated at 166 second-feet. Canal dry from December to May. Discharge June 13-22 estimated at 190 second-feet.

Monthly discharge, in second-feet, of Black River canal (flowing south) near Boonville, N. Y., for the year ending Sept. 30, 1917.

Month.	Maximum.	Minimum.	Mean.
October	250	185	210
November	263		206
December	0	0	0
January	0	0	0
February	0	0	0
March	0	0	0
April	0	0	0
May	0	0	0
June	245	a 130	189
July	197	a 154	183
August	187	141	173
September	181	151	169
The year	263	0	94.4

a Estimated.

MOOSE RIVER AT MOOSE RIVER, N. Y.

Location.—In the village of Moose River, Lewis County, about 3 miles downstream from McKeever, 5 miles below mouth of South Branch of Moose River, and nearly 20 miles above junction of Black and Moose rivers at Lyons Falls.

Drainage area.—370 square miles (measured on topographic maps).

Records available.—June 5, 1900, to September 30, 1917.

Gage.—Staff in two sections on left bank a short distance above the cable; read by Mrs. Martha Hannan and H. W. Hoch. Gage datum was lowered 0.17 foot February 28, 1903, and again 5.00 feet on January 1, 1913.

Discharge measurements.—Made from a cable a short distance below gage.

Channel and control.—Cobblestones and boulders; fairly permanent. Current smooth; depth comparatively uniform. Ice and logs occasionally jam above the station on a small island.

Extremes of discharge.—Maximum stage recorded during year, 13.2 feet at 8 a. m. June 12 (discharge, about 7,460 second-feet); minimum stage recorded 5.05 feet at 8 a. m. August 5 and 6 (discharge, 58 second-feet).

1900–1917: Maximum stage recorded, 16.3 feet during the afternoon of March 27, 1913, determined by leveling from flood marks (discharge, about 16,500 second-feet); minimum stage recorded, 4.94 feet July 21, 23, 25, 26, and 27, 1913 (discharge, about 42 second-feet).

Ice.—Stage-discharge relation affected by ice.

Regulation.—A timber dam at McKeever, 3 miles upstream, is used for power and for the regulation of flow during log driving. Seasonal distribution of flow affected by operation of the State dam at Old Forge. This regulation is indicated by a record from station "Middle Branch of Moose River at Old Forge."

Accuracy.—Stage-discharge relation practically permanent; affected by ice for a large part of the period from December to March. Rating curve fairly well defined between 100 and 5,500 second-feet. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records fairly good except for periods when the discharge is low or the stage-discharge relation is affected by ice for which they are fair.

Discharge measurements of Moose River at Moose River, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 7	A. H. Davison	6.27	383	Feb. 9[a]	A. H. Davison	7.02	333
11	....do	6.08	331	Mar. 8[a]	....do	7.64	465
Jan. 12[a]	....do	6.80	367	June 5	O. W. Hartwell	7.22	781

[a] Measurement made through complete ice cover.

Daily discharge, in second-feet, of Moose River at Moose River, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	715	460	2,270	440	320	650	2,090	2,270	1,750	910	176	352
2	540	460	1,520	650	360	700	3,060	2,180	1,590	1,080	164	230
3	500	580	670	280	320	700	4,490	2,090	760	1,020	216	500
4	460	625	965	280	320	300	3,740	1,910	965	1,080	216	500
5	460	422	965	280	460	550	3,280	1,520	860	1,080	69	386
6	386	625	1,830	340	340	440	2,460	1,020	860	860	126	289
7	404	580	1,590	340	320	460	2,460	1,380	965	580	146	304
8	121	500	1,260	550	320	420	1,910	1,320	1,140	500	114	289
9	422	500	1,450	480	340	300	1,750	1,450	1,750	580	304	87
10	352	540	1,910	380	420	80	1,200	1,450	1,520	500	404	304
11	289	760	1,520	400	220	240	1,320	1,450	3,060	500	670	289
12	289	580	1,200	380	600	320	1,450	1,450	6,310	910	230	151
13	289	580	1,080	380	500	480	1,320	1,590	2,860	670	352	151
14	289	500	810	340	420	550	1,140	1,450	2,360	500	320	216
15	500	500	760	600	340	440	715	1,590	2,090	441	230	189
16	441	500	670	850	320	460	860	1,830	1,910	500	259	138
17	460	500	600	700	260	480	1,020	1,590	1,910	540	259	352
18	404	500	550	750	380	320	1,200	1,450	2,090	441	289	259
19	422	386	600	700	280	480	1,590	1,260	1,450	386	151	244
20	422	460	600	440	360	460	3,740	1,140	1,200	386	304	259
21	1,200	404	550	340	400	480	5,630	1,450	1,450	441	164	230
22	1,320	460	400	460	460	480	5,320	1,260	1,320	176	103	202
23	965	386	420	460	420	500	4,230	1,140	1,140	336	320	87
24	760	2,270	340	420	380	700	3,620	1,260	580	320	126	352
25	580	2,660	130	400	220	750	3,060	1,380	965	320	422	230
26	404	1,080	480	340	550	950	2,660	1,520	860	289	500	202
27	422	910	340	380	480	1,200	2,560	810	1,020	202	289	259
28	500	860	380	160	500	2,660	2,180	1,450	860	230	320	244
29	336	810	340	300	....	2,560	1,590	1,750	810	164	244	289
30	460	1,670	400	340	....	2,270	2,000	2,460	760	336	289	103
31	460	....	220	300	....	2,000	....	2,180	....	289	320	......

NOTE.—Discharge Dec. 17 to Mar. 27 estimated, because of ice, from discharge measurements, weather records, and study of gage-height graph.

Monthly discharge of Moose River at Moose River, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 370 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,320	121	502	1.36	1.57
November	2,660	386	736	1.99	2.22
December	2,270	130	865	2.34	2.70
January	850	160	434	1.17	1.35
February	600	220	379	1.02	1.06
March	2,660	80	754	2.04	2.35
April	5,630	715	2,450	6.62	7.39
May	2,460	810	1,550	4.20	4.84
June	6,310	580	1,570	4.25	4.74
July	1,080	164	534	1.44	1.66
August	670	69	261	.706	.81
September	500	87	256	.692	.77
The year	6,310	69	858	2.32	31.46

MIDDLE BRANCH OF MOOSE RIVER AT OLD FORGE, N. Y.

Location.—About 300 feet below highway bridge and 400 feet below State dam at Old Forge, Herkimer County.

Drainage area.—51.5 square miles (measured on topographic maps).

Records available.—November 9, 1911, to September 30, 1917.

Gage.—Vertical staff on left bank 300 feet below highway bridge; read by Jacob Edick.

Discharge measurements.—Made from highway bridge or by wading near gage.

Channel and control.—Bed near gage composed of stone and gravel. Control is rock ledge about 200 feet below gage; practically permanent.

Extremes of discharge.—Maximum stage recorded during year, 3.9 feet at 8 a. m. and 5 p. m. June 16 (stage-discharge relation affected by backwater from Moose River). Maximum discharge, 405 second-feet, computed from records at Old Forge dam. Minimum stage occurs when the gates of the dam are closed, discharge being due to leakage and discharge through the fish hatchery.

1911–1917: Maximum stage recorded, 6.3 feet March 28, 1913; stage-discharge relation affected by backwater from Moose River; discharge computed from records at dam, 760 second-feet.

Ice.—Stage-discharge relation not affected by ice.

Regulation.—Flow controlled by dam.

Accuracy.—Stage-discharge relation practically permanent between dates of shift; not affected by ice. Rating curve well defined from 20 to 400 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying to rating table mean daily gage height weighted on days of changing gates from records of gate opening at dam. Records good except those computed from gate openings at the dam, which are fair.

Discharge measurements of Middle Branch of Moose River at Old Forge, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 18	A. H. Davison	0.33	2.88	July 18	C. C. Covert	1.68	38.5
18	....do	3.35	426	Aug. 16	E. D. Burchard	1.17	23.6
18	....do	3.35	443	16	....do	1.50	61.1
June 5	O. W. Hartwell	1.15	23.3				

Daily discharge, in second-feet, of Middle Branch of Moose River at Old Forge, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	165	135	30	44	75	142	207	198	142	173	25	30
2	165	135	35	45	75	142	198	198	26	173	25	30
3	165	135	35	46	75	142	195	198	26	173	25	30
4	165	135	32	47	75	142	194	150	37	173	25	28
5	165	135	33	49	75	142	193	26	67	136	25	30
6	165	135	37	51	75	142	192	32	200	60	25	28
7	165	135	47	52	75	142	190	43	200	60	50	26
8	165	135	53	56	75	142	190	59	150	65	110	25
9	157	135	58	55	75	135	190	150	80	65	110	80
10	142	115	60	56	75	135	190	207	225	173	110	23
11	142	80	60	56	75	135	190	207	307	350	110	22
12	150	80	62	58	70	135	190	207	405	158	110	26
13	150	80	55	60	70	135	190	207	405	65	110	80
14	150	80	45	70	70	135	190	207	405	44	110	104
15	150	80	40	70	70	135	190	205	405	34	110	104
16	142	80	40	70	69	135	190	165	405	30	110	104
17	142	80	40	70	68	135	182	135	405	33	110	104
18	142	80	40	70	122	135	182	135	290	135	92	104
19	142	75	40	70	165	135	182	97	165	210	61	104
20	150	80	40	70	157	135	182	26	173	100	61	104
21	150	80	40	75	157	135	180	26	173	25	63	104
22	150	38	41	75	157	165	190	30	173	25	65	104
23	142	24	42	75	150	182	210	40	173	25	65	98
24	142	26	43	75	150	182	220	59	181	40	65	98
25	142	27	43	75	142	182	223	182	181	30	60	98
26	142	28	43	75	142	182	225	200	181	25	48	98
27	142	28	43	75	142	182	225	200	173	25	26	98
28	142	28	43	75	142	182	225	200	173	25	23	98
29	142	28	43	75	....	190	225	200	173	25	23	98
30	142	29	43	75	....	198	207	200	173	25	27	98
31	142	....	44	75	....	198	....	225	....	25	29	......

NOTE.—Discharge Apr. 3–8, 21–26, May 14, 15, 26–30, June 6, 7, 12–17, July 11, 18, 19, Sept. 1–3, and 5–8 determined, because of backwater from Moose River or logs on control, from records at Old Forge dam.

Monthly discharge of Middle Branch of Moose River at Old Forge, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 51.5 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	165	142	150	2.91	3.36
November	135	24	83.0	1.61	1.80
December	62	30	43.5	.845	.97
January	75	44	64.2	1.25	1.44
February	165	68	102	1.98	2.06
March	198	135	153	2.97	3.42
April	225	180	198	3.84	4.28
May	225	26	142	2.76	3.18
June	405	26	209	4.06	4.53
July	350	25	87.3	1.70	1.96
August	110	23	64.8	1.26	1.45
September	104	22	72.6	1.41	1.57
The year	405	22	114	2.21	30.02

BEAVER RIVER AT STATE DAM NEAR BEAVER RIVER, N. Y.

LOCATION.—At concrete storage dam at outlet of Beaver River flow, about 7½ miles west of Beaver River postoffice, Herkimer County, and 7 miles above Beaver Lake at Number Four.

DRAINAGE AREA.—176 square miles (measured on topographic maps).

RECORDS AVAILABLE.—May 11, 1908, to September 30, 1917.

GAGES.—Elevation of water surface in the reservoir is determined by a staff gage in two sections, on the west corner of the gage house; read by James Dunbar, gate tender. The mean elevation of the crest of the spillway is at gage height 16.96 feet. Prior to September 28, 1913, elevation of water surface was determined by measuring the distance from the water surface to a reference point set at the elevation of the crest of the spillway. Widths of sluice gate openings determined by measuring on the gate stems the distance they have been raised.

DISCHARGE MEASUREMENTS.—Current-meter measurements made from a temporary foot bridge at the mouth of the outlet tunnel, below the gates. Discharge over the spillway has not been measured.

DETERMINATION OF DISCHARGE.—Records include the discharge through one or more of four 4-foot circular sluice gates, when opened, the discharge over the spillway, and the discharge through the logway at the west end of the spillway. The sluice gates have been rated by current-meter measurements made at different lake elevations but no measurements have been made of the discharge over the spillway or through the logway. Theoretic coefficients based on the Cornell experiments [1] have been used to compute ratings for the spillway and logway.

REGULATION.—At ordinary stages the discharge of Beaver River is completely regulated by the operation of the sluice gates.

EXTREMES OF STAGE.—Maximum elevation of water surface in reservoir recorded during year, 18.8 feet on April 22; minimum stage recorded 4.5 feet on October 19.

1908–1917: Maximum elevation of water surface in reservoir, 19.46 feet March 29, 1913; minimum stage, 2.9 feet September 29 and October 1, 1913.

EXTREMES OF DISCHARGE.—Maximum daily discharge during year, 1,960 second-feet April 23; minimum discharge, zero, during periods when gates were closed and there was no flow over spillway.

1908–1917: Maximum discharge, 3,300 second-feet on May 2, 1911.

ACCURACY.—Stage-discharge relation permanent; probably not affected by ice. Rating curves for sluice gates well defined. Lake gage read to half tenths once daily. The accuracy of computations depends to a large extent on the care with which the gates were set to the recorded openings. Records fair.

Discharge measurements of Beaver River at State dam near Beaver River, N. Y., during the year ending Sept. 30, 1917.

[Made by A. H. Davison.]

Date.	Gate. No.	Gate. Opening.	Lake gage height.	Discharge.	Date.	Gate. No.	Gate. Opening.	Lake gage height.	Discharge.
		Inches.	*Feet.*	*Sec.-ft.*			*Inches.*	*Feet.*	*Sec.-ft.*
Oct. 10	4	48	6.22	131	Oct. 10	1	36	6.40	123
10	4	36	6.22	118	10	1	45	6.39	137
10	4	24	6.24	99.8	10	3	12	6.39	50.5
10	4	12	6.28	51.2	10	3	24	6.42	95.6
10	1	12	6.36	52.8	11	3	36	6.50	118
10	1	24	6.39	98.0					

NOTE.—All measurements made from temporary bridge at mouth of tunnel.

[1] U. S. Geol. Survey Water-Supply Paper 200.

Monthly discharge of Beaver River at State dam near Beaver River, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 176 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	167	93	126	0.716	0.83
November	206	113	172	.977	1.09
December	244	210	237	1.35	1.56
January	241	234	238	1.35	1.56
February	237	216	228	1.30	1.35
March	243	212	216	1.23	1.42
April	1,960	246	1,080	6.14	6.85
May	1,010	368	588	3.34	3.85
June	1,260	368	562	3.19	3.56
July	412	139	211	1.20	1.38
August	256	83	221	1.26	1.45
September	243	213	231	1.31	1.46
The year	1,960	83	342	1.94	26.36

STREAMS TRIBUTARY TO ST. LAWRENCE RIVER.

EAST BRANCH OF OSWEGATCHIE RIVER AT NEWTON FALLS, N. Y.

LOCATION.—600 feet below lower dam of Newton Falls Paper Co., in Newton Falls, St. Lawrence County, 4 miles above mouth of Little River and 10 miles below outlet of Cranberry Lake.

DRAINAGE AREA.—166 square miles (measured by engineers of New York Conservation Commission).

RECORDS AVAILABLE.—October 6, 1912, to September 30, 1917.

GAGE.—Vertical staff on left bank 600 feet above lower dam; read by Alfred Renaud and Henay Van Waldick.

DISCHARGE MEASUREMENTS.—Made by wading, or from cable 30 feet upstream from gage.

CHANNEL AND CONTROL.—Small boulders and rock covered with waste from pulp mill; practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.8 feet at 6.30 p. m. June 12 and 14 (discharge, 894 second-feet); minimum stage is reached nearly every Sunday during low-water period when paper mills shut down.

1912–1917; maximum stage recorded, 6.1 feet at 5.15 p. m. March 28, 1913 (discharge, 2,200 second-feet).

ICE.—Stage-discharge relation affected by ice only for a short time during extremely cold weather.

REGULATION.—Some diurnal fluctuation in flow caused by operation of paper mills. Seasonal flow largely controlled by storage at Cranberry Lake.

ACCURACY.—Stage-discharge relation practically permanent; not affected by ice during year. Rating curve well defined between 20 and 1,200 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying to the rating table weighted mean gage height based on observer's notes concerning operation of paper mills. Records good.

The following discharge measurement was made through incomplete ice cover by A. H. Davison:

January 18, 1918: Gage height, 1.83 feet; discharge, 282 second-feet.

Daily discharge, in second-feet, of East Branch of Oswegatchie River at Newton Falls, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	119	262	350	223	304	262	242	460	350	150	180	350
2	282	326	350	350	282	223	282	402	402	262	304	210
3	326	304	223	350	326	148	350	460	300	304	188	402
4	304	326	350	304	75	99	402	588	376	188	490	376
5	188	93	376	262	262	205	376	658	376	180	196	350
6	262	223	376	223	350	282	350	554	350	180	196	304
7	262	304	376	171	282	304	402	554	350	188	188	304
8	304	242	376	242	242	223	262	588	402	100	376	326
9	262	326	350	326	155	196	350	588	350	196	376	200
10	282	326	242	304	171	205	326	460	300	223	350	262
11	262	350	376	304	282	223	304	402	490	223	376	376
12	262	99	460	262	350	196	350	402	894	242	200	304
13	262	350	430	326	402	171	350	326	852	196	350	282
14	242	304	402	155	402	242	282	522	852	205	350	205
15	148	262	402	262	376	242	205	588	810	119	304	262
16	223	326	402	304	196	282	242	460	810	402	350	205
17	350	326	99	304	180	223	223	402	350	223	304	402
18	326	326	304	304	282	126	242	350	376	188	304	402
19	350	155	402	304	304	223	304	402	522	171	326	402
20	326	326	402	148	205	205	326	304	430	180	402	402
21	262	350	402	140	223	188	554	350	402	223	262	402
22	196	326	402	282	205	262	460	326	402	188	180	402
23	304	326	350	304	163	326	554	315	402	171	223	300
24	304	350	99	304	112	326	460	304	300	262	376	430
25	350	376	126	326	54	140	376	262	376	302	350	350
26	304	188	588	304	242	262	376	350	402	402	205	402
27	326	326	376	304	326	460	350	304	376	402	460	304
28	304	350	376	75	304	460	376	460	304	376	402	350
29	81	402	350	262	......	430	350	460	205	200	304	304
30	196	376	326	350	......	402	460	304	304	304	326	304
31	223	......	112	326	......	376	......	402	......	350	304	......

NOTE.—No gage-height record, discharge estimated for the following days: May 23, June 3, 10, 17, 24, July 1, 8, 29, Aug. 12, Sept. 2, 9, and 23.

Monthly discharge of East Branch of Oswegatchie River at Newton Falls, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 166 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	350	81	264	1.59	1.83
November	402	93	298	1.79	2.00
December	588	99	340	2.05	2.36
January	350	75	271	1.63	1.88
February	402	54	252	1.52	1.58
March	460	99	255	1.54	1.78
April	554	205	350	2.11	2.35
May	658	262	429	2.58	2.97
June	894	205	447	2.69	3.00
July	402	100	235	1.42	1.64
August	460	180	307	1.85	2.13
September	430	200	329	1.98	2.21
The year	894	54	315	1.90	25.73

NOTE.—Table shows run-off as regulated at Cranberry Lake and by paper mills at Newton Falls.

OSWEGATCHIE RIVER NEAR HEUVELTON, N. Y.

LOCATION.—2½ miles above Heuvelton, St. Lawrence County, 3 miles below Rensselaer Falls, and 7 miles above mouth of Indian River (outlet to Black Lake).

DRAINAGE AREA.—961 square miles (measured on topographic maps).

RECORDS AVAILABLE.—June 23, 1916, to September 30, 1917.

GAGE.—Gurley seven-day water-stage recorder on the right bank, about 2½ miles above Heuvelton, installed September 16, 1916. Prior to this date gage height was determined by measuring the distance from a reference point to the water surface. Recorder inspected by George Todd.

CHANNEL AND CONTROL.—Solid rock.

EXTREMES OF DISCHARGE.—Maximum stage, from water-stage recorder, 7.6 feet from 9 to 12 a. m. March 30 (discharge, 11,700 second-feet); minimum stage from water-stage recorder, 0.91 foot at 11 p. m. October 16 (discharge 320 second-feet).

ICE.—Stage-discharge relation slightly affected by ice.

REGULATION.—Some diurnal fluctuation due to operation of mills at Rensselaer Falls and above. Seasonal flow regulated by storage in Cranberry Lake.

ACCURACY.—Stage-discharge relation permanent except as affected by ice January 11 to March 22. Rating curve well defined between 400 and 15,000 second-feet. Operation of water-stage recorder satisfactory throughout the year. Daily discharge June 23 to September 15, 1916, ascertained by applying to rating table daily gage height obtained from two observations of stage per day; discharge September 16, 1916, to September 30, 1917, except for period of ice effect, ascertained by applying to rating table mean daily gage height obtained from gage-height graph. Open-water records good; winter records fair.

Discharge measurements of Oswegatchie River near Heuvelton, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 27	A. H. Davison	2.00	1,190	Apr. 9	A. H. Davison	4.48	4,880
Jan. 16[a]	.....do	2.15	1,320	13	.....do	2.95	2,390
Feb. 14[a]	.....do	1.72	698	July 16	C. C. Covert	1.43	681
Mar. 12[a]	.....do	1.99	995	Aug. 14	E. D. Burchard	1.24	506
30	.....do	7.60	11,600	14	.....do	1.22	504
30	.....do	7.59	11,700	Sept. 27	.....do	1.30	556
Apr. 5	.....do	5.51	6,870	28	.....do	1.26	534

[a] Measurement made through incomplete ice cover.

Daily discharge, in second-feet, of Oswegatchie River near Heuvelton, N. Y., for period June 23, 1916, to Sept. 30, 1917.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1916.					1916.				
1	....	881	662	485	16	....	622	548	302
2	....	836	622	459	17	....	662	513	340
3	....	881	622	478	18	....	746	548	398
4	....	836	548	440	19	....	836	548	325
5	....	746	387	145	20	....	928	513	340
6	....	746	387	180	21	....	881	548	376
7	....	746	446	478	22	....	881	478	375
8	....	702	446	499	23	1,550	836	446	375
9	....	662	478	478	24	1,430	836	472	376
10	....	622	478	446	25	1,340	836	414	376
11	....	622	478	478	26	1,170	791	414	409
12	....	662	548	360	27	1,130	702	404	452
13	....	622	622	414	28	1,080	746	409	440
14	....	622	662	414	29	1,080	702	340	406
15	....	585	622	446	30	1,020	662	433	440
					31	....	746	466	......

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1916–17.												
1	414	570	1,230	734	1,000	1,000	9,700	1,840	1,980	918	592	746
2	409	548	1,300	710	1,100	1,300	8,100	1,980	1,840	1,060	562	800
3	479	541	1,320	710	1,100	1,400	7,050	2,180	1,690	1,160	485	900
4	694	608	1,310	678	1,100	1,300	6,850	2,320	1,510	1,040	420	900
5	686	710	1,230	719	1,100	1,300	6,850	2,110	1,410	1,000	446	890
6	646	818	1,230	890	1,000	1,300	6,850	2,180	1,410	918	513	890
7	585	836	1,510	1,120	950	1,300	6,250	2,040	1,300	827	499	845
8	534	791	1,840	1,410	850	1,100	5,860	1,910	1,290	746	485	782
9	485	746	1,910	1,490	800	1,100	4,920	1,840	1,370	678	472	818
10	452	737	1,910	1,480	750	1,100	4,040	1,730	1,600	630	459	719
11	466	710	2,040	1,400	700	1,100	3,370	1,630	3,590	630	446	638
12	459	719	2,180	1,400	650	1,000	2,750	1,580	4,920	694	426	638
13	446	845	2,180	1,400	650	1,000	2,390	1,680	4,920	800	485	615
14	426	854	1,910	1,300	600	1,000	2,180	1,910	4,650	755	485	600
15	392	764	1,650	1,300	600	1,100	1,910	1,980	4,300	694	492	615
16	382	728	1,410	1,300	650	1,100	1,720	1,980	3,700	686	478	570
17	433	854	1,240	1,300	750	1,100	1,540	1,840	3,130	702	485	592
18	578	662	1,240	1,400	800	1,300	1,400	1,630	2,600	737	478	520
19	600	654	1,140	1,300	750	1,500	1,330	1,550	2,180	737	541	534
20	578	608	890	1,200	750	1,500	1,430	1,330	1,910	694	548	520
21	638	662	881	1,100	650	1,400	1,910	1,230	1,580	764	492	492
22	686	630	863	1,000	700	1,500	2,600	1,140	1,410	630	478	506
23	773	615	863	900	750	2,460	3,210	1,260	1,330	578	485	......
24	900	670	836	800	700	5,670	3,370	1,280	1,230	646	459	......
25	947	702	800	750	600	8,540	3,210	1,430	1,120	622	485	......
26	918	893	800	800	600	11,000	2,820	1,680	985	630	592	......
27	835	1,190	755	800	700	11,400	2,530	1,730	909	608	881	......
28	752	1,310	710	800	900	11,200	2,390	1,840	947	570	890	506
29	670	1,370	702	850	....	11,400	2,180	1,690	909	555	800	520
30	646	1,300	782	900	....	11,700	2,040	1,910	928	555	719	513
31	570	....	758	950	....	11,000	....	2,040	....	555	728	......

NOTE.—Discharge, Sept. 22 and 23, 1916, estimated. Discharge, Jan. 11 to Mar. 24, estimated, because of ice, from discharge measurements, weather records, study of gage height graph, and comparison with open-water records for Harrisville. Discharge Sept. 23-27, 1917, estimated at 500 second-feet.

Monthly discharge of Oswegatchie River near Heuvelton, N. Y., for the period July 1, 1916, to Sept. 30, 1917.

[Drainage area, 961 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1916.					
July	928	585	748	0.779	0.90
August	662	340	500	.520	.60
September	499	145	403	.419	.47
1916–17.					
October	947	382	596	.620	.71
November	1,370	541	788	.820	.91
December	2,180	702	1,270	1.32	1.52
January	1,490	678	1,060	1.10	1.27
February	1,100	600	795	.828	.86
March	11,700	1,000	3,590	3.73	4.30
April	9,700	1,330	3,760	3.91	4.36
May	2,320	1,140	1,760	1.83	2.11
June	4,920	909	2,090	2.17	2.42
July	1,160	565	736	.766	.88
August	890	420	542	.564	.65
September	900	492	623	.645	.72
The year	11,700	382	1,470	1.53	20.71

WEST BRANCH OF OSWEGATCHIE RIVER NEAR HARRISVILLE, N. Y.

Location.—At highway bridge near Geers Corners, 2½ miles downstream from Harrisville, Lewis County.

Drainage area.—245 square miles (measured on topographic maps and map of New York, issued by U. S. Geol. Survey; scale, 1:500,000).

Records available.—July 1, 1916, to September 30, 1917.

Gage.—Vertical staff in three sections on the right bank; section graduated from 0.0 to 3.3 feet about 25 feet below bridge, and two sections graduated from 3.3 to 10.1 feet, on downstream side of bridge abutment. Gage read by Frank Osborne.

Discharge measurements.—Made from cable 200 feet upstream from bridge, or by wading.

Channel and control.—Rocky and rough; probably permanent.

Extremes of discharge.—Maximum stage recorded during year, 8.1 feet at 6.30 a. m. and 6 p. m. March 28 (discharge, 4,880 second-feet); minimum stage recorded, 1.10 feet at 6 p. m. August 11 (discharge, 42 second-feet).

Ice.—Stage-discharge relation probably not affected by ice.

Regulation.—Operation of pulp mill at Harrisville causes some diurnal fluctuation.

Accuracy.—Stage-discharge relation practically permanent; not affected by ice. Rating curve well defined between 50 and 4,000 second-feet. Gage read to half tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of West Branch of Oswegatchie River near Harrisville, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 17[a]	A. H. Davison	2.95	440	Apr. 3	A. H. Davison	6.47	2,960
Feb. 12[a]	....do	1.82	128	8	....do	5.10	1,700
Mar. 10[a]	....do	2.30	246	12	....do	3.70	797
Apr. 2	....do	5.62	2,220	June 8	O. W. Hartwell	2.97	455
2	....do	5.70	2,210				

[a] Measurement made through incomplete ice cover.

Daily discharge, in second-feet, of West Branch of Oswegatchie River near Harrisville, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	370	135	560	208	440	335	1,960	650	650	480	85	370
2	290	182	560	220	440	370	2,130	600	560	422	85	370
3	245	220	520	195	480	388	3,090	650	440	370	85	352
4	195	320	440	195	405	405	3,410	700	480	260	64	352
5	170	335	480	195	335	305	2,890	750	440	232	79	245
6	146	335	650	290	290	320	2,490	650	405	195	62	195
7	79	305	850	352	275	320	2,040	700	405	146	50	245
8	85	275	800	370	245	260	1,800	650	480	170	50	220
9	63	245	700	440	220	275	1,420	600	750	124	51	170
10	63	260	850	480	245	305	1,150	560	850	146	70	170
11	85	305	1,030	460	275	275	970	560	970	146	91	170
12	66	305	970	422	195	275	850	650	1,280	195	56	158
13	98	320	750	290	195	320	750	750	1,490	275	124	146
14	85	290	650	290	195	335	650	750	1,210	220	70	106
15	208	195	560	388	170	305	600	750	970	170	78	85
16	195	245	560	405	170	305	560	700	750	182	58	91
17	158	245	650	440	170	320	480	650	650	158	74	74
18	124	220	460	440	170	335	560	560	520	170	62	106
19	135	182	370	405	158	275	650	480	440	208	63	106
20	170	124	305	370	158	335	800	405	405	208	64	106
21	245	124	275	388	158	352	1,350	480	405	232	91	79
22	405	124	220	335	146	335	1,960	460	370	182	79	98
23	405	158	220	305	124	388	1,880	560	335	208	66	106
24	370	335	275	275	146	850	1,720	650	290	195	85	70
25	320	480	232	275	146	1,210	1,350	750	275	124	440	79
26	260	650	232	245	158	2,310	1,090	850	305	146	388	77
27	220	560	208	208	195	3,520	850	850	245	170	275	91
28	220	560	220	245	335	4,880	750	800	245	124	232	60
29	208	480	232	158	....	3,980	750	800	220	124	170	91
30	170	460	245	260	....	3,090	700	850	388	91	220	146
31	170	....	220	370	....	2,400	....	800	....	62	352	......

Monthly discharge of West Branch of Oswegatchie River near Harrisville, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 245 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	405	63	194	0.792	0.91
November	650	124	299	1.22	1.36
December	1,030	208	493	2.01	2.32
January	480	158	320	1.31	1.51
February	480	124	237	.967	1.01
March	4,880	260	957	3.91	4.51
April	3,410	480	1,390	5.67	6.23
May	850	405	665	2.71	3.12
June	1,490	220	574	2.34	2.61
July	480	62	198	.808	.93
August	440	50	123	.502	.58
September	370	60	158	.645	.72
The year	4,880	50	468	1.91	25.81

RAQUETTE RIVER AT PIERCEFIELD, N. Y.

LOCATION.—Half a mile below dam of International Paper Co. at Piercefield, St. Lawrence County, and about three-fourths mile above head of Black Rapids.

DRAINAGE AREA.—723 square miles (all but 16 square miles measured on topographic maps).

RECORDS AVAILABLE.—August 20, 1908, to September 30, 1917.

GAGE.—Stevens water-stage recorder installed October 22, 1912 in a galvanized sheet-iron house over a concrete well on right bank about one-half mile below dam. Prior to January 1, 1913, the following gages were used: August 20, 1908 to August 20, 1910, vertical staff fastened to an old pine stump; August 20, 1910, to December 31, 1912, chain fastened to same stump and having same datum until June 1, 1911, when datum of chain gage was lowered 2 feet. Water-stage recorder was set at this datum. Recorder inspected by M. O. Wood.

DISCHARGE MEASUREMENTS.—Made from a cable three-fourths mile below gage, just above Black Rapids.

CHANNEL AND CONTROL.—Channel opposite gage is a deep pond with no perceptible velocity. Control is at head of Black Rapids.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 9.75 feet at 9 a. m. April 30 (discharge, 4,950 second-feet); minimum stage, from water stage recorder, 1.69 feet at 6 p. m. October 29 (discharge, 48 second-feet.)

1908–1917: Maximum stage, from water-stage recorder, 11.68 feet at 3 a. m. April 1, 1913 (discharge, 7,100 second-feet); minimum stage, from water-stage recorder, 0.85 foot at 11 a. m. September 2, 1913 (discharge, about 10 second-feet).

ICE.—Rapids that form control rarely freeze; measurements made when the pond was covered with ice indicate that the stage-discharge relation was not affected.

REGULATION.—Large diurnal fluctuation in flow caused by operation of dam during low and medium stages. Numerous lakes in upper part of drainage basin afford considerable storage, most of which is so controlled, that the effect on the seasonal distribution of flow is large.

ACCURACY.—Stage-discharge relation practically permanent; not affected by ice. Rating curve well defined between 50 and 7,000 second-feet. Operation of water-stage recorder satisfactory throughout the year. Daily discharge ascertained by use of discharge integrator. Records good.

COOPERATION.—Water-stage recorder inspected by an employee of the International Paper Co.

Discharge measurements of Raquette River at Piercefield, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 2	A. H. Davison	3.92	474	Jan. 13	A. H. Davison	5.16	948
2	.....do	3.99	481	Apr. 17	.....do	7.85	2,820
8	.....do	1.83	59.1	17	.....do	7.84	2,830
14	.....do	2.31	109	17	.....do	7.81	2,780
14	.....do	2.29	104	June 1	O. W. Hartwell	7.51	2,470
15	.....do	1.96	69.1	July 27	C. C. Covert	5.40	986

Daily discharge, in second-feet, of Raquette River at Piercefield, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	62	428	872	1,030	895	545	1,530	4,700	2,450	2,350	486	524
2	200	377	940	1,060	895	530	2,150	4,540	2,260	2,300	485	234
3	230	395	655	900	895	545	2,670	4,380	2,510	2,260	522	101
4	230	425	1,080	1,070	390	266	3,040	4,270	2,460	1,740	492	383
5	230	246	1,100	980	639	408	3,380	4,180	2,480	2,110	235	516
6	225	395	1,040	879	895	562	3,680	3,970	2,440	2,060	416	520
7	140	425	1,330	540	686	647	4,260	3,900	2,400	1,890	542	510
8	65	440	1,290	742	545	545	3,690	3,750	2,500	1,570	532	525
9	250	425	1,380	892	715	562	4,050	3,580	2,500	1,760	480	236
10	236	425	1,030	878	895	530	3,980	3,420	2,340	1,530	354	349
11	233	460	1,430	906	348	249	3,870	3,350	2,750	1,480	337	500
12	235	271	1,590	800	700	476	3,780	3,220	3,220	1,460	194	481
13	227	457	1,560	723	880	620	3,640	3,060	3,480	1,420	276	465
14	156	515	1,580	476	880	624	3,380	3,070	3,600	1,390	306	334
15	70	515	1,550	897	870	617	3,180	2,950	3,740	920	370	325
16	198	500	1,580	918	870	610	3,080	2,880	3,810	1,330	353	186
17	253	500	966	918	784	608	2,820	2,790	3,750	1,260	363	291
18	245	500	1,560	918	288	268	2,730	2,720	3,830	1,060	370	498
19	244	294	1,590	900	428	530	2,580	2,660	3,810	944	224	490
20	243	441	1,390	872	562	623	2,740	2,470	3,680	655	298	475
21	336	470	1,380	425	545	633	3,030	2,500	3,620	534	372	508
22	180	470	1,380	661	562	620	3,480	2,470	3,540	516	368	496
23	359	485	1,300	756	545	696	3,900	2,450	3,350	368	430	257
24	380	500	564	918	545	500	4,280	2,410	3,080	535	525	337
25	380	530	700	848	273	222	4,630	2,390	3,230	535	570	518
26	395	350	1,240	940	414	821	4,830	2,400	3,070	510	260	508
27	365	652	1,370	895	562	1,060	4,900	2,290	2,840	524	380	500
28	443	830	1,370	448	562	1,160	4,880	2,420	2,660	538	496	492
29	214	830	1,380	760	......	1,190	4,850	2,420	2,600	274	530	487
30	428	872	1,200	918	......	2,490	4,830	2,420	2,520	407	522	230
31	485	......	573	918	......	1,590	......	2,470	......	510	520	......

Monthly discharge of Raquette River at Piercefield, for the year ending Sept. 30, 1917.

[Drainage area, 723 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	485	62	256	0.354	0.41
November	872	246	481	.665	.74
December	1,590	564	1,220	1.69	1.95
January	1,070	425	832	1.15	1.33
February	895	288	643	.890	.93
March	2,490	249	689	.953	1.10
April	4,900	1,530	3,590	4.96	5.53
May	4,700	2,290	3,110	4.30	4.96
June	3,830	2,260	3,020	4.18	4.66
July	2,350	274	1,180	1.63	1.89
August	570	194	408	.565	.65
September	525	101	409	.566	.63
The year	4,900	62	1,320	1.83	24.78

NOTE.—Minimum discharge for each month occurred on Sunday.

ST. REGIS RIVER AT BRASHER CENTER, N. Y.

Location.—Near steel highway bridge in Brasher Center, St. Lawrence County, 5 miles downstream from Brasher Falls, 6½ miles below junction of East and West branches of St. Regis River and about 12 miles above mouth.

Drainage area.—621 square miles (measured on Post Route map).

Records available.—August 22, 1910, to September 30, 1917.

Gages.—Staff, with inclined and vertical sections, on right bank about 600 feet above bridge; installed June 24, 1916. Prior to this date, chain on right-hand downstream side of bridge. Gages not at same datum; subject to different controls. Gage read by George Myers.

Discharge measurements.—Made from a cable at the staff gage, installed in June 1916. Previously made from the highway bridge, or by wading.

Channel and control.—Bed at cable composed of small boulders and coarse gravel; large boulders and gravel, and very rough at bridge; fairly permanent.

Extremes of discharge.—Maximum stage recorded during year, 9.58 feet at 5 p. m. April 3 (discharge, 6,030 second-feet); minimum stage recorded 5.25 feet at 5 p. m. August 8 (discharge about 34 second-feet).

1910–1917: Maximum stage recorded, 9.1 feet at 7 a. m. March 27, 1914 (discharge, 16,200 second-feet); minimum stage recorded, August 8, 1917.

Ice.—Stage-discharge relation seriously affected by ice.

Accuracy.—Stage-discharge relation practically permanent, except as affected by ice December 12 to March 25. Rating curves well defined between 200 and 6,000 second-feet. Gage read to quarter-tenths twice daily. Daily discharge, except for period of ice effect, ascertained by applying mean daily gage height to rating table. Open-water records good; winter records fair.

Discharge measurements of St. Regis River at Brasher Center, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 15[a]	A. H. Davison	7.12	544	Apr. 4	A. H. Davison	9.39	5,600
Feb. 15[a]	.....do	7.02	332	10	.....do	7.73	2,390
Mar. 13[a]	.....do	7.09	487	14	.....do	7.25	1,680
29	.....do	8.72	4,150	Sept. 1	C. C. Covert	6.27	473
29	.....do	8.70	4,120				

[a] Measurement made through complete ice cover.

Daily discharge, in second-feet, of St. Regis River at Brasher Center, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	571	395	695	190	300	650	3,350	1,730	1,050	870	100	675
2	552	395	940	240	300	600	4,540	1,590	930	930	55	645
3	395	395	810	240	360	550	5,850	1,520	1,050	810	50	758
4	322	452	752	260	380	650	5,400	1,590	1,180	645	50	685
5	335	418	940	300	340	650	4,960	1,450	1,050	567	44	492
6	322	395	1,050	380	340	500	4,750	1,240	1,050	492	61	492
7	372	372	875	500	300	400	4,330	1,050	990	456	50	340
8	283	410	940	600	320	400	3,530	1,120	1,240	492	37	291
9	322	350	940	500	360	400	3,170	1,310	1,660	474	50	319
10	259	380	1,050	460	320	380	2,340	1,180	1,730	456	75	372
11	237	514	940	480	340	340	1,880	1,050	2,180	348	130	404
12	283	571	1,000	400	340	400	1,800	1,310	2,500	520	202	348
13	270	452	850	300	340	500	1,730	1,660	2,880	645	158	348
14	372	350	750	280	300	500	1,590	1,730	2,880	492	121	291
15	395	283	800	300	280	400	1,310	1,880	2,500	492	215	270
16	444	322	850	380	300	360	1,120	1,520	2,340	456	372	232
17	452	270	320	600	220	360	930	1,050	2,030	492	456	202
18	452	328	340	500	280	480	1,240	810	1,450	456	348	158
19	478	350	300	480	260	550	1,590	870	1,120	372	254	170
20	495	365	340	440	220	600	2,030	810	930	388	372	242
21	810	350	260	500	240	600	2,660	930	758	586	456	291
22	1,050	372	240	420	300	500	3,170	1,180	990	474	548	456
23	940	322	260	320	300	700	3,170	1,730	810	372	645	520
24	695	590	240	340	320	1,300	3,170	1,660	810	404	548	388
25	571	1,300	240	440	300	2,500	2,500	1,730	758	319	456	270
26	495	752	200	500	340	3,920	2,180	1,730	665	270	348	232
27	452	642	180	380	480	4,330	1,880	1,730	685	270	291	319
28	395	600	220	380	800	4,960	1,590	1,590	685	319	372	291
29	350	642	200	260	....	3,920	1,520	1,450	665	254	319	372
30	365	611	240	320	....	2,830	1,660	1,310	758	202	348	404
31	342	....	260	320	....	2,660	....	1,240	....	158	548	....

NOTE.—Discharge Dec. 12 to Mar. 25, estimated, because of ice from discharge measurements, weather records and study of gage-height graph.

Monthly discharge of St. Regis River at Brasher Center, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 621 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,050	237	454	0.731	0.84
November	1,300	270	465	.749	.84
December	1,050	180	581	.936	1.08
January	600	190	387	.623	.72
February	800	220	332	.535	.56
March	4,960	340	1,220	1.96	2.26
April	5,850	930	2,700	4.35	4.85
May	1,880	810	1,380	2.22	2.56
June	2,880	665	1,340	2.16	2.41
July	930	158	467	.752	.87
August	645	37	261	.420	.48
September	758	158	376	.605	.68
The year	5,850	37	830	1.34	18.15

RICHELIEU RIVER AT FORT MONTGOMERY, ROUSES POINT, N. Y.

LOCATION.—Inside the fort, three-eighths mile south of international boundary, about half a mile below outlet of Lake Champlain, and 1 mile northeast of Rouses Point, Clinton County.

DRAINAGE AREA.—7,870 square miles, including 436 square miles of water surface (from annual report of New York State Engineer and Surveyor).

RECORDS AVAILABLE.—1875 to 1917.

GAGE.—Staff, inside of fort; read by Thomas Bourke. Elevation of gage zero, 92.50 feet above mean sea level.

EXTREMES OF STAGE.—Maximum elevation recorded during year, 98.25 feet at 10 a. m. April 8 and 9; minimum elevation recorded, 93.3 feet at 10 a. m. November 20 and 21.

1869–1917: Maximum elevation recorded, 103.28 feet April, 1869;[1] minimum elevation recorded, 91.9 feet November 13, 1908.

COOPERATION.—Gage heights observed under direction of the Corps of Engineers of the United States Army and reported weekly to the United States Geological Survey.

Daily gage height, in feet, of Richelieu River at Fort Montgomery, Rouses Point, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.15	1.05	1.20	1.90	1.95	1.80	4.50	5.45	4.15	3.70	2.55	1.85
2	1.15	1.00	1.30	1.75	1.95	1.80	4.90	5.30	3.75	3.65	2.55	1.85
3	1.20	1.00	1.40	1.80	1.95	1.80	5.10	5.15	3.70	3.60	2.55	1.75
4	1.20	1.00	1.60	1.80	1.95	1.80	5.35	5.10	3.65	3.50	2.45	1.70
5	1.25	1.00	1.55	1.80	1.95	1.85	5.45	5.05	3.65	3.50	2.35	1.65
6	1.15	1.00	1.55	1.80	1.95	1.85	5.60	5.00	3.60	3.50	2.35	1.80
7	1.20	1.05	1.50	1.85	2.00	1.85	5.70	4.95	3.60	3.50	2.30	1.60
8	1.20	1.20	1.55	1.85	1.95	1.90	5.75	4.90	3.60	3.50	2.35	1.60
9	1.00	1.20	1.75	1.80	1.95	1.90	5.75	4.80	3.50	3.50	2.35	1.65
10	1.05	.95	1.70	1.75	1.95	1.85	5.65	4.60	3.50	......	2.25	1.50
11	1.05	.90	1.70	1.75	1.95	1.85	5.65	4.60	3.50	3.50	2.25	1.50
12	1.05	.90	1.70	1.85	1.90	1.90	5.65	4.55	4.00	3.35	2.20	1.75
13	1.40	.85	1.70	1.80	1.90	1.95	5.60	4.55	4.25	3.35	2.25	1.50
14	.85	.85	1.80	1.80	1.90	1.90	5.50	4.60	4.40	3.25	2.25	1.45
15	1.10	.90	1.80	1.80	1.90	1.90	5.45	4.40	4.35	3.25	2.25	1.40
16	.90	.90	1.75	1.85	1.90	1.90	5.35	4.40	4.40	3.25	2.20	1.35
17	1.10	1.05	1.80	1.90	1.90	2.00	5.25	4.40	4.35	3.10	2.15	1.35
18	.90	.90	1.80	1.90	1.90	1.95	5.20	4.40	4.35	3.05	2.10	1.30
19	1.20	.90	1.80	1.85	1.85	1.95	5.10	4.30	4.40	3.05	2.10	1.35
20	.95	.80	1.80	1.90	1.85	1.95	5.35	4.15	4.35	3.05	2.30	1.30
21	1.00	.80	1,75	1.85	1.85	1.90	5.40	4.10	4.40	3.05	2.10	1.30
22	1.05	.90	1.75	1.90	1.80	1.90	5.45	4.10	4.35	3.15	2.10	1.25
23	1.10	.95	1.75	1.95	1.80	2.00	5.50	4.20	4.30	3.05	2.15	1.35
24	1.10	1.00	1.80	1.95	1.80	2.15	5.45	4.20	4.20	3.00	2.10	1.35
25	1.15	.90	1.75	1.95	1.80	2.40	5.50	4.00	4.10	3.00	2.15	1.30
26	1.20	.95	1.80	1.95	1.80	2.70	5.55	3.90	4.15	3.00	2.10	1.30
27	1.10	1.30	1.80	1.95	1.80	3.05	5.50	3.80	4.00	2.95	2.10	1.30
28	1.05	1.15	1.80	1.95	1.80	3.50	5.35	3.80	3.90	2.75	2.00	1.30
29	1.35	1.10	1.80	2.00	......	3.85	5.35	3.80	3.90	2.75	1.95	1.25
30	1.20	1.05	1.80	1.95	......	4.10	5.35	3.75	3.75	2.70	1.85	1.25
31	1.05	......	1.85	1.95	......	4.30	......	3.80	......	2.60	1.80	......

SARANAC RIVER NEAR PLATTSBURG, N. Y.

LOCATION.—At Indian Rapids power plant (formerly known as Lozier dam) of Plattsburg Gas & Electric Co., about 6 miles above mouth of river at Plattsburg, Clinton County.

DRAINAGE AREA.—607 square miles (measured on topographic maps).

RECORDS AVAILABLE.—March 27, 1903, to September 30, 1917.

[1] Hoyt, J. C., Stream measurements, 1903, North Atlantic, St. Lawrence River and Great Lakes drainage: U. S. Geol. Survey Water-Supply Paper 97, p. 340, 1904.

GAGES.—Crest gage a vertical staff on the angle of the wing wall at the end of the racks. Datum raised 0.76 foot August 20, 1906. Tailrace gage a vertical staff spiked to timber work dike between tailrace and river and about 50 feet below power house. Records of kilowatt output are obtained by watt meter on switchboard at half-hour intervals. Inclined staff gage at cable station, a quarter of a mile below dam. Gages and watt meters read by power-house operators.

DISCHARGE MEASUREMENTS.—Made from a cable at head of Indian Rapids, one quarter mile below dam. Low-water measurements made by wading under cable or in tailrace.

DISCHARGE RATING.—Records include flow over concrete spillway 171.25 feet in crest length, a rating for which has been prepared for use of coefficients[a] derived from experiments made in the hydraulic laboratory of Cornell University on a model section of the dam; the discharge through two power units equipped with 300 kilowatt generators which have been rated by current meter measurements; and the discharge through two 5-foot waste gates when open. Occasional observations are made on the inclined staff gage at the cable as a check on the ratings of spillway and turbines.

EXTREMES OF DISCHARGE.—Maximum daily discharge during year, 5,400 second-feet April 3; minimum daily discharge 100 second-feet August 29.

1908–1917: Maximum daily discharge recorded, 6,410 second-feet, April 20, 1914; minimum daily discharge recorded, 90 second-feet, September 28, 1914.

SPECIAL STUDY.—A portable water-stage recorder was operated at the cable for a short period in July, 1914. Mean daily discharge computed from its record agreed very closely with mean daily discharge derived from power-plant ratings.

ICE.—The crest of the spillway is kept free from ice so that the stage-discharge relation is not affected.

REGULATION.—The lakes and ponds on the main stream and tributaries above the station comprise a water surface area of about 25.5 square miles. The actual storage afforded by these reservoirs has been largely increased by the State dam at Lower Saranac Lake, the operation of which affects the distribution of flow throughout the year.

ACCURACY.—Discharge measurements made during the year indicate that the ratings of spillway and turbines have not changed. Discharge over the spillway ascertained by applying to rating table mean gage heights for 6-hour periods. Discharge through the turbines ascertained by applying to their ratings, the mean kilowatt output and head for 12-hour periods. Records fair.

COOPERATION.—Gage-height records and watt meter readings furnished by Plattsburg Gas & Electric Co., Herbert A. Stutchbury, superintendent.

Discharge measurements of Saranac River near Plattsburg, N. Y., during the year ending Sept. 30. 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 4	O. W. Hartwell	4.58	4,560	Apr. 6	O. W. Hartwell	3.98	3,310
4	.....do	4.53	4,470	6	.....do	3.90	3,000
4	.....do	4.44	4,240	Aug. 30[b]	C. C. Covert	1.83	300
4	.....do	4.45	4,300				

[a] Horton, R. E., Weir experiments, coefficients, and formulas: U. S. Geol. Survey Water-Supply Paper 200, pp. 98–100, 1907.
[b] Measurement made in tailrace; no appreciable flow over spillway.

Daily discharge, in second-feet, of Saranac River near Plattsburg, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	230	370	660	460	520	820	3,400	1,250	1,060	1,140	270	400
2	370	400	580	470	560	780	4,600	1,140	1,000	1,160	290	330
3	270	370	500	580	490	660	5,400	1,450	920	1,080	470	380
4	270	330	580	560	350	500	4,300	1,300	1,200	980	430	280
5	280	270	580	490	500	660	3,500	1,250	740	960	290	230
6	250	450	660	680	380	580	3,000	1,120	840	940	400	270
7	310	380	640	580	540	540	3,000	1,250	860	980	260	245
8	195	420	660	640	580	600	2,350	1,120	1,100	760	240	380
9	360	410	600	620	540	600	1,850	1,060	1,300	820	320	245
10	380	560	680	660	480	540	1,700	1,080	1,040	680	450	300
11	360	410	700	580	300	440	1,220	1,060	1,500	800	310	230
12	270	300	800	540	540	540	1,450	1,200	2,600	740	260	250
13	360	340	560	460	350	360	1,220	1,140	2,250	780	260	205
14	310	410	620	410	460	540	1,200	930	2,000	840	210	250
15	270	410	700	640	580	470	1,220	1,020	1,800	700	320	260
16	360	380	560	580	600	540	1,160	980	1,450	900	320	210
17	300	390	380	620	540	530	1,140	920	1,500	680	400	310
18	390	350	640	640	380	480	1,160	980	1,450	660	450	280
19	360	310	460	560	480	620	1,350	760	1,350	840	300	290
20	380	340	500	540	380	480	1,900	740	1,250	740	340	1,180
21	520	360	680	420	410	500	2,450	800	1,400	700	270	840
22	400	310	560	540	390	560	2,800	860	1,240	660	290	620
23	680	360	480	420	400	560	2,500	1,100	1,120	660	290	440
24	400	430	330	520	460	820	2,300	1,250	920	660	320	470
25	400	560	500	560	370	900	2,050	1,080	1,140	940	310	300
26	450	230	500	480	480	1,650	1,800	1,180	1,060	580	260	310
27	460	450	440	400	560	2,500	1,700	1,060	920	580	540	250
28	450	480	560	350	760	3,300	1,700	900	920	640	210	740
29	290	520	580	520	......	3,200	1,400	820	1,100	740	100	840
30	500	640	540	460	......	2,900	1,400	1,100	1,300	640	210	920
31	360	......	310	540	......	2,400	......	1,040	......	700	270	......

Monthly discharge of Saranac River near Plattsburg, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 607 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	680	[a] 195	361	0.595	0.69
November	640	[a] 230	405	.667	.74
December	800	[a] 210	568	.936	1.08
January	680	[a] 350	533	.878	1.01
February	760	[a] 300	478	.787	.82
March	3,300	[a] 440	1,010	1.66	1.91
April	5,400	1,140	2,210	3.64	4.06
May	1,450	[a] 740	1,060	1.75	2.02
June	2,600	740	1,280	2.11	2.35
July	1,160	580	796	1.31	1.51
August	470	100	312	.514	.59
September	1,180	205	408	.672	.75
The year	5,400	100	782	1.29	17.53

[a] Sunday.

AUSABLE RIVER AT AUSABLE FORKS, N. Y.

Location.—In village of Ausable Forks, Clinton County, immediately below junction of East and West branches and about 15 miles above mouth of river.

Drainage area.—444 square miles (measured on topographic maps).

Records available.—August 17, 1910, to September 30, 1917.

Gage.—Chain on left bank 1,000 feet below junction of East and West branches; read by A. S. Baker.

Discharge measurements.—Made from a cable 1½ miles below gage, or by wading either near the cable or a short distance above the gage.

Channel and control.—Stone and gravel; occasionally shifting. Channel divided by an island opposite the gage.

Extremes of discharge.—Maximum stage recorded during year, 6.95 feet at 6 p. m., April 2 (discharge, 7,580 second-feet); minimum discharge, 110 second-feet, February 18.

1910–1917: Maximum stage recorded, 10.2 feet in the evening of March 27, 1913 (discharge, roughly 25,000 second-feet); minimum stage recorded, 3.0 feet at 7 a. m. July 21, 1912 (discharge, practically zero).

Special study.—A portable water-stage recorder was installed at this station and a continuous gage-height record obtained July 11 to September 30, 1914, which showed a continual small fluctuation in stage, It was shown that monthly mean discharge based on a semidaily gage heights is in error as follows: July 11–31, 3.5 per cent; August, 4.1 per cent; September, 1914, 0.5 per cent. Some of the determinations of daily discharge showed greater errors, but these were largely compensating.

Ice.—Stage-discharge relation slightly affected by ice.

Accuracy.—Stage-discharge relation probably permanent between dates of shifting; affected by ice for short periods from December to March. Rating curve fairly well defined between 175 and 3,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Ausable River at Ausable Forks, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 17	C. C. Covert	3.67	287	Apr. 5	O. W. Hartwell	4.99	2,280
Jan. 22[a]	A. H. Davison	3.90	274	5	.....do	4.97	2,210
Feb. 16[a]	.....do	3.74	170	Aug. 28	C. C. Covert	3.52	160
Mar. 14[a]	.....do	3.64	213				

[a] Measurement made through complete ice cover.

Daily discharge, in second-feet, of Ausable River at Ausable Forks, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	484	287	1,110	260	160	460	2,490	1,160	2,160	851	345	319
2	371	280	776	260	160	380	6,800	1,200	1,620	751	955	1,070
3	287	336	526	260	220	340	5,890	1,100	2,490	536	1,530	407
4	242	336	465	260	280	280	3,190	1,350	2,160	446	2,720	287
5	196	302	851	260	300	260	2,160	851	1,440	465	2,270	250
6	208	319	1,350	300	220	220	1,830	800	1,440	336	1,620	242
7	189	280	825	340	160	220	1,730	739	1,160	287	2,160	227
8	202	272	634	300	120	200	1,440	1,100	1,730	257	2,050	214
9	214	302	702	300	120	200	984	599	1,530	221	2,490	202
10	208	484	1,070	340	180	180	800	839	1,620	214	388	257
11	221	465	668	280	130	180	851	727	5,310	214	287	214
12	214	388	600	280	320	220	679	1,200	5,600	287	214	221
13	202	336	420	200	240	220	1,260	1,160	2,840	398	221	208
14	234	272	360	180	220	220	764	984	1,830	319	202	227
15	319	234	300	650	220	220	578	1,100	1,620	264	214	170
16	272	242	260	550	260	220	557	929	1,130	250	242	132
17	302	221	240	500	120	260	567	903	984	221	227	177
18	302	250	220	360	110	240	588	1,070	1,040	214	....	183
19	250	227	220	440	220	240	955	2,070	702	189	....	170
20	407	272	200	340	170	280	2,490	3,070	679	142	....	916
21	1,260	196	200	280	160	240	6,190	1,940	1,440	157	....	702
22	788	234	200	280	170	319	5,310	1,260	567	164	....	465
23	557	264	200	320	130	465	3,320	1,530	484	153	177	319
24	426	1,730	200	220	130	1,060	3,070	1,440	1,230	202	199	272
25	354	750	200	140	120	1,260	1,730	1,260	2,050	153	189	250
26	354	550	240	140	160	1,440	1,440	1,260	484	214	177	221
27	319	400	426	140	800	2,380	1,210	1,350	345	157	189	202
28	264	340	354	130	500	3,950	1,100	727	319	153	183	214
29	242	360	300	140	....	2,050	1,130	1,530	336	153	189	354
30	214	1,130	280	150	....	1,350	1,440	3,320	2,050	157	257	294
31	257	....	280	130	....	998	....	3,320	....	132	272	......

NOTE.—Discharge Nov. 25-29, Dec. 12-23, and Dec. 29 to Mar. 21, estimated, because of ice, from discharge measurements, weather records, and study of gage-height graph. Discharge Aug. 18-22, estimated because of no gage-height record, 220 second-feet.

Monthly discharge of Ausable River at Ausable Forks, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 444 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,260	189	334	0.752	0.87
November	1,730	196	402	.905	1.01
December	1,350	200	473	1.07	1.23
January	650	130	282	.635	.73
February	800	100	218	.491	.51
March	3,950	180	663	1.49	1.72
April	6,800	557	2,080	4.68	5.22
May	3,320	727	1,350	3.04	3.50
June	5,600	319	1,610	3.63	4.05
July	851	142	279	.629	.73
August	2,720	177	679	1.53	1.76
September	1,070	132	313	.704	.79
The year	6,800	100	724	1.63	22.12

WEST BRANCH OF AUSABLE RIVER NEAR NEWMAN, N. Y.

Location.—On farm of James Dudley, about 4 miles northeast of Newman, Essex County, and 4 miles below confluence at Lake Placid.

Drainage area.—116 square miles (measured on topographic maps).

Records available.—June 7, 1916, to September 30, 1917.

Gage.—Staff, in two sections, on the right bank near the residence of Mr. Dudley. Lower section is inclined, graduated from 1.0 to 6.5 feet; the upper section is vertical graduated from 6.55 to 10.1 feet; read by James Dudley.

Discharge measurements.—Made by wading or from cable 300 feet above gage.

Channel and control.—Solid rock.

Extremes of stage.—Maximum stage recorded, 6.2 eet at 6 p. m. June 22; minimum stage recorded, 1.7 feet at 7 p. m. June 28.

Data inadequate for determination of discharge.

Discharge measurements of West Branch of Ausable River near Newman, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Aug. 3	A. H. Davison	2.64	61	Apr. 16	A. H. Davison	3.22	162
Jan. 20[a]	....do	3.08	105	Aug. 29	C. C. Covert	2.78	92
Apr. 16	....do	3.11	131				

[a] Measurement made through complete ice cover.

Daily gage height, in feet, of West Branch of Ausable River at Newman, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	May.	June.	July.	Aug.	Sept.
1	3.12	2.75	3.68	3.9	4.25	3.35	2.3	2.85
2	2.85	2.9	3.3	3.98	4.4	3.35	2.4	3.18
3	2.82	2.98	3.52	3.8	4.85	3.15	2.3	2.85
4	2.72	2.85	3.4	3.82	4.1	3.22	2.4	2.72
5	2.8	2.82	3.25	3.52	3.85	2.95	2.4	2.65
6	2.52	2.82	3.95	3.48	3.95	2.9	2.32	2.68
7	2.72	2.72	3.55	3.5	3.68	2.98	2.35	2.8
8	2.68	2.7	3.48	3.35	4.1	2.7	2.88	2.68
9	2.68	3.05	3.45	3.28	4.35	2.78	2.85	2.62
10	2.68	3.35	3.85	3.52	3.72	2.7	3.08	2.62
11	2.65	3.1	3.55	3.45	4.52	2.62	2.65	2.6
12	2.5	2.88	3.38	3.82	5.6	2.88	2.62	2.58
13	2.7	2.8	3.05	3.78	4.4	2.9	2.68	2.82
14	3.22	2.75	3.42	3.75	4.08	2.85	2.42	2.58
15	2.82	2.88	3.4	4.0	3.88	2.78	2.52	2.38
16	2.7	2.8	3.2	3.65	3.8	2.7	2.58	2.42
17	2.85	2.85	2.82	3.5	3.75	2.72	2.65	2.45
18	2.82	2.72	2.85	3.9	3.75	2.66	2.7	2.42
19	2.82	2.8	2.8	3.6	2.8	2.75	2.62	2.52
20	3.68	2.72	2.75	4.4	3.8	2.7	2.6	3.98
21	4.1	2.52	2.65	4.32	4.02	2.65	2.6	3.25
22	3.45	2.5	2.65	3.8	4.1	2.68	2.58	2.95
23	3.15	2.65	2.88	4.22	3.98	2.6	2.52	2.78
24	2.92	4.95	2.95	4.15	3.85	2.42	2.58	2.72
25	2.65	3.72	2.75	3.88	3.75	2.68	2.58	2.68
26	2.9	3.4	2.92	3.85	3.8	2.65	2.55	2.52
27	2.85	3.15	2.95	3.72	3.75	2.52	2.52	2.52
28	2.75	3.02	2.98	4.02	3.62	2.5	2.45	2.78
29	2.65	2.98	2.98	4.12	3.52	2.4	2.65	2.98
30	2.62	3.82	2.85	4.42	4.68	2.45	2.82	2.88
31	2.6	....	2.85	4.52	....	2.48	3.02	....

Note.—Gage-height observations suspended because of ice, Jan. 1 to Apr. 30.

LAKE GEORGE AT ROGERS ROCK, N. Y.

Location.—At boathouse in a small bay on north side of steamboat landing at Rogers Rock, Essex County.

Drainage area.—Not measured.

Records available.—July 10, 1913, to September 30, 1917.

Gage.—Vertical staff fastened to a pile in the back end of the boathouse. Datum 3.15 feet[1] below crest of dam at outlet of lake; read once daily by George O. Cook.

Extremes of stage.—Maximum stage recorded during year, 4.05 feet June 14, 15, 16, and 21; minimum stage recorded, 1.2 feet on November 21 and December 22.

1913–1917 maximum stage recorded, 4.98 feet on May 2, 1914; minimum stage recorded 1.2 feet on November 21 and December 22, 1916.

Regulation.—The elevation of lake surface is regulated by the operation of gates and wheels at the dam at the outlet of the lake at Ticonderoga.

Cooperation.—Gage-height record for current year furnished by International Paper Co.

Daily gage height, in feet, of Lake George at Rogers Rock, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.05	1.52	1.38	1.4	1.7	1.65	2.48	3.18	3.2	4.03	3.57	2.88
2	2.02	1.55	1.32	1.35	1.72	1.6	2.5	3.25	3.12	4.0	3.53	2.9
3	1.92	1.52	1.35	1.3	1.7	1.62	2.7	3.2	3.15	3.95	3.52	2.87
4	1.95	1.5	1.4	1.32	1.72	1.6	2.8	3.12	3.18	3.9	3.48	2.85
5	1.98	1.5	1.42	1.35	1.65	1.58	2.88	3.12	3.15	3.87	3.4	2.8
6	1.92	1.48	1.5	1.42	1.7	1.55	2.88	3.1	3.1	3.85	3.35	2.82
7	1.90	1.52	1.4	1.45	1.68	1.6	2.98	3.15	3.15	3.85	3.33	2.78
8	1.95	1.5	1.38	1.42	1.65	1.65	3.0	3.2	3.2	3.87	3.37	2.75
9	1.85	1.48	1.38	1.4	1.68	1.68	3.02	3.18	3.2	3.78	3.4	2.8
10	1.82	1.45	1.38	1.3	1.65	1.68	3.0	3.22	3.22	3.77	3.33	2.7
11	1.82	1.42	1.4	1.35	1.65	1.7	2.98	3.18	3.25	3.75	3.3	2.68
12	1.80	1.35	1.35	1.38	1.65	1.68	3.0	3.1	3.8	3.8	3.25	2.65
13	1.82	1.3	1.32	1.4	1.7	1.6	3.02	3.08	4.00	3.78	3.23	2.62
14	1.70	1.38	1.4	1.5	1.7	1.62	3.0	3.1	4.05	3.77	3.25	2.6
15	1.72	1.3	1.35	1.52	1.68	1.68	3.0	3.0	4.05	3.75	3.22	2.55
16	1.68	1.35	1.42	1.58	1.72	1.68	3.05	3.1	4.0	3.8	3.2	2.53
17	1.88	1.35	1.35	1.62	1.7	1.7	3.0	3.05	3.98	3.78	3.18	2.5
18	1.52	1.35	1.4	1.68	1.65	1.75	3.0	3.02	4.05	3.75	3.15	2.47
19	1.58	1.38	1.35	1.68	1.62	1.72	3.0	3.1	4.02	3.82	3.1	2.5
20	1.6	1.15	1.32	1.7	1.6	1.7	3.05	3.0	4.0	3.8	3.0	2.5
21	1.75	1.2	1.3	1.8	1.55	1.68	3.12	3.0	4.05	3.78	3.15	2.48
22	1.70	1.3	1.2	1.72	1.6	1.68	3.18	3.02	4.0	3.8	2.98	2.4
23	1.72	1.3	1.3	1.7	1.65	1.7	3.2	3.05	3.98	3.75	2.95	2.45
24	1.7	1.35	1.4	1.75	1.65	1.75	3.15	3.02	3.95	3.7	3.0	2.45
25	1.78	1.4	1.42	1.72	1.6	1.8	3.12	3.0	3.95	3.72	3.07	2.43
26	1.72	1.3	1.35	1.72	1.65	1.9	3.1	3.02	3.98	3.75	3.0	2.42
27	1.68	1.3	1.42	1.68	1.6	2.0	3.15	3.0	4.0	3.65	2.98	2.4
28	1.65	1.35	1.4	1.7	1.62	2.2	3.12	3.02	3.92	3.63	3.0	2.38
29	1.6	1.4	1.35	1.72	....	2.38	3.12	3.1	3.98	3.6	2.97	2.37
30	1.5	1.4	1.3	1.75	....	2.4	3.15	3.08	4.02	3.57	2.88	2.35
31	1.52	....	1.35	1.72	....	2.45	....	3.18	....	3.53	2.85	......

LAKE CHAMPLAIN AT BURLINGTON, VT.

Location.—On south side of roadway leading to dock of Champlain Transportation Co., at foot of King street, Burlington.

Records available.—May 1, 1907, to September 30, 1917.

Gage.—Staff. Comparisons of gage readings indicate that zero of gage at Burlington is at practically the same elevation as that of gage at Fort Montgomery—92.5 feet above mean sea level. Gage read by employee of the Champlain Transportation Co.

[1] Determined by levels; supersedes the estimated datum previously published.

EXTREMES OF STAGE.—Maximum stage recorded during year, 6.20 feet April 10–11; minimum stage recorded, 0.95 foot November 24–25.

1907–1917: Maximum stage recorded, 8.20 feet on April 7, 1913; minimum stage recorded, −0.25 foot on December 4, 1908.

ICE.—Wider portions of lake not usually frozen over until the last part of January. Occasionally closure does not occur until February and in some years it lasts only for a few days. The northern end of the lake, above the outlet, is usually covered with ice from the middle of December to the middle of April.

ACCURACY.—Gage read to hundredths once a day except on Sundays; readings during winter at irregular intervals. Gage readings made when the lake is rough subject to inaccuracies due to wave action.

COOPERATION.—Gage-height record furnished through the courtesy of Mr. D. A. Loomis, general manager of the Champlain Transportation Co.

Daily gage height, in feet, of Lake Champlain at Burlington, Vt., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	......	1.11	1.50	1.80	......	......	......	5.65	4.15	......	2.80	1.96
2	1.25	1.13	1.52	1.80	......	......	5.15	5.63	4.13	4.00	2.74	......
3	1.20	1.15	......	......	......	......	5.50	5.60	......	3.98	2.70	1.85
4	1.20	1.15	1.60	......	......	......	5.76	5.55	4.08	3.98	2.65	1.85
5	1.18	......	1.65	......	2.00	......	5.87	5.48	4.02	3.96	......	1.82
6	1.15	1.11	1.68	......	......	1.95	5.98	......	3.95	3.90	2.53	1.78
7	1.13	1.05	1.75	......	......	......	6.05	5.35	3.90	3.80	2.47	1.78
8	......	1.00	1.88	1.82	......	......	......	5.28	3.87	......	2.44	1.76
9	1.05	1.00	1.92	......	......	......	6.18	5.20	3.83	3.68	2.40	......
10	1.06	1.00	......	......	......	......	6.20	5.15	......	3.55	2.37	1.74
11	1.03	1.00	1.95	......	......	......	6.20	5.08	3.98	3.50	2.30	1.74
12	1.02	......	1.98	......	1.98	......	6.05	5.02	4.30	3.48	......	1.72
13	1.02	1.05	2.00	......	......	1.98	5.98	......	4.52	3.42	2.25	1.69
14	1.00	1.05	2.02	......	......	......	5.90	4.95	4.65	3.38	2.25	1.68
15	......	1.04	2.02	......	......	......	......	4.93	4.82	......	2.20	1.65
16	1.00	1.04	2.03	......	......	......	5.75	4.90	4.86	3.30	2.18	......
17	.98	1.02	......	......	......	......	5.68	4.82	......	3.28	2.13	1.61
18	.98	1.02	2.06	2.10	......	......	5.62	4.70	4.83	3.25	2.16	1.59
19	.98	......	2.05	......	1.96	......	5.65	4.62	4.78	3.20	......	1.59
20	.98	.99	2.06	......	......	2.05	5.70	......	4.75	3.20	2.21	1.58
21	.98	.99	2.02	......	......	......	5.72	4.45	4.72	3.18	2.24	1.62
22	......	.97	2.02	2.10	......	......	......	4.42	4.65	......	2.28	1.60
23	1.18	.97	1.98	......	......	......	5.85	4.38	4.58	3.15	2.30	......
24	1.24	.95	......	......	......	......	5.90	4.38	......	3.10	2.30	1.57
25	1.24	.95	......	......	......	......	5.95	4.36	4.55	3.02	2.28	1.52
26	1.21	......	1.94	......	1.90	2.70	5.92	4.30	4.48	2.95	......	1.48
27	1.20	1.08	1.93	......	......	3.08	5.85	......	4.35	2.92	2.20	1.46
28	1.18	1.19	1.91	......	......	3.74	5.80	4.22	4.30	2.90	2.13	1.46
29	......	1.32	1.91	2.03	......	4.28	......	4.20	4.13	......	2.10	1.46
30	1.14	1.36	1.90	......	......	4.58	5.72	4.20	4.02	2.87	2.04	......
31	1.11	......	......	......	......	4.72	......	4.16	......	2.87	1.98	......

NOTE.—Thickness of ice 100 feet from dock: Jan. 29, 5 inches; Feb. 5, 9 inches; Feb. 12, 12.5 inches; Feb. 19, 15.75 inches; Feb. 26, 17 inches; Mar. 6, 17.5 inches; Mar. 13, 17.75 inches; Mar. 20, 16.75 inches; Mar. 26, 13 inches.

OTTER CREEK AT MIDDLEBURY, VT.

LOCATION.—At railroad bridge half a mile south of railroad station at Middlebury, Addison County, 3½ miles below mouth of Middlebury River, and 3½ miles above mouth of New Haven River.

DRAINAGE AREA.—615 square miles.

RECORDS AVAILABLE.—April 1, 1903, to May 1, 1907; October 5, 1910, to September 30, 1917.

GAGE.—Chain; read by Alexander Hamilton.

DISCHARGE MEASUREMENTS.—Made from a boat just below railroad bridge, at the stone-arch highway bridge just above dam, or by wading.

CHANNEL AND CONTROL.—Channel deep; current sluggish for several miles above the station. Control for low stages is gravel and boulder rips about 800 feet below gage, probably somewhat shifting; control at high stages is near the dam 800 feet farther downstream.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 16.3 feet at 7.15 a. m. April 2 (discharge 3,680 second-feet); minimum stage recorded during year, 11.65 feet at 7.15 a. m. October 9 (discharge, 175 second-feet).

1903–1907 and 1910–1917: Maximum stage recorded, 21.07 feet March 30, 1913 (discharge, from extension of rating curve, about 8,000 second-feet); minimum open-water stage recorded, 11.45 feet September 15, 1913 (discharge, 138 second-feet). A somewhat lower discharge has probably occurred at various times when the stage-discharge relation has been affected by ice.

ICE.—Ice forms to a considerable thickness at the gage and occasionally at the control, affecting the stage-discharge relation.

REGULATION.—Probably little if any effect from power developments above the station. Considerable storage has been developed on tributaries near the headwaters.

ACCURACY.—Stage-discharge relation has changed somewhat in previous years, but apparently no change during 1916–17. Rating curve well defined between 200 and 4,000 second-feet. Gage read to quarter-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table, with corrections for ice during winter as shown in foot note to daily discharge table. Records good.

Discharge measurements of Otter Creek at Middlebury, Vt., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 28	Hardin Thweatt	12.47	581	Mar. 30	H. H. Khachadoorian	16.05	3,530
Feb. 19	H. H. Khachadoorian	a 12.35	357	31	....do	16.09	3,510
Mar. 12	....do	a 12.90	570	31	C. H. Pierce	16.10	3,440
12	....do	a 12.90	568	July 27	M. R. Stackpole	11.85	237

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Otter Creek at Middlebury, Vt., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	426	283	1,880	360	475	1,790	3,500	1,970	1,270	320	283	340
2	403	283	1,970	360	475	1,700	3,680	1,700	1,070	501	248	360
3	320	320	880	360	450	1,440	3,590	1,700	810	426	381	320
4	320	320	1,360	381	426	810	3,410	1,610	810	320	340	426
5	283	283	1,030	381	403	740	3,410	1,440	810	283	248	360
6	265	265	1,070	450	403	640	3,320	1,270	670	360	202	320
7	248	301	1,070	740	403	555	3,230	1,360	610	360	232	320
8	283	320	1,030	775	360	475	3,140	1,360	1,030	283	248	340
9	175	301	810	705	360	555	2,960	1,270	1,790	232	265	283
10	232	320	917	640	360	501	2,780	1,270	1,700	301	403	217
11	265	320	1,030	670	340	555	2,420	1,070	1,610	301	1,070	265
12	248	340	917	610	320	582	1,970	1,190	2,870	301	283	283
13	248	283	810	582	340	528	1,880	1,190	2,690	340	232	265
14	248	283	670	555	360	501	1,440	1,190	2,690	360	232	283
15	320	283	640	1,110	381	501	1,190	1,150	2,510	360	283	265
16	217	283	610	1,360	403	501	1,030	1,030	2,330	403	301	265
17	283	320	610	1,190	426	555	955	880	2,150	501	320	217
18	283	320	555	1,110	381	740	992	810	1,610	360	381	232
19	301	340	360	880	340	740	1,190	740	1,270	360	320	283
20	320	301	381	670	381	555	1,440	775	955	450	301	320
21	810	320	450	610	426	475	2,330	775	810	426	320	320
22	1,030	320	360	501	426	555	2,330	775	705	360	340	283
23	610	301	450	670	426	705	2,510	705	610	217	301	265
24	501	740	705	501	426	1,520	2,510	845	610	301	283	217
25	403	1,790	705	450	403	1,880	2,690	992	740	283	283	202
26	301	1,520	610	450	381	2,240	2,690	992	670	283	340	232
27	283	1,270	501	426	528	2,510	2,690	1,030	640	248	248	232
28	283	955	501	403	1,610	3,410	2,600	880	610	248	265	248
29	320	740	426	403	......	3,410	2,510	775	582	283	265	248
30	217	775	450	426	......	3,410	2,330	1,270	610	265	283	265
31	283	......	360	475	......	3,590	......	1,440	......	265	340	......

NOTE.—Stage-discharge relation affected by ice Jan. 21 and Jan. 26 to Mar. 25; discharge determined from gage heights corrected for effect of ice by means of 3 discharge measurements, observer's notes, and weather records.

Monthly discharge of Otter Creek at Middlebury, Vt., for the year ending Sept. 30, 1917.

[Drainage area 615 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,030	175	346	0.563	0.65
November	1,790	265	493	.802	.89
December	1,970	360	778	1.27	1.46
January	1,360	360	619	1.01	1.16
February	1,610	320	444	.722	.75
March	3,590	475	1,250	2.03	2.34
April	3,680	955	2,420	3.93	4.38
May	1,970	705	1,140	1.85	2.13
June	2,870	582	1,260	2.05	2.29
July	610	217	332	.540	.62
August	1,070	202	317	.515	.59
September	426	202	283	.460	.51
The year	3,680	175	807	1.31	17.77

WINOOSKI RIVER AT MONTPELIER, VT.

LOCATION.—One mile downstream from Central Vermont Railway station in Montpelier, Washington County, about three eighths of a mile above mouth of Dog River, and 1¼ miles below mouth of Worcester Branch.

DRAINAGE AREA.—420 square miles.

RECORDS AVAILABLE.—May 19, 1909, to September 30, 1917.

GAGE.—Gurley seven-day water-stage recorder installed July 4, 1914, on right bank; gage heights referred to datum by means of a hook gage inside the well; an outside staff gage is used for auxiliary readings; records June 16 to July 3, 1914, obtained from the staff gage. Chain gage at highway bridge just above the Central Vermont Railway station used from May 19, 1909, to June 30, 1914.

DISCHARGE MEASUREMENTS.—Made from a cable or by wading.

CHANNEL AND CONTROL.—Channel deep and fairly uniform in section at the gage, control is formed by sharply defined rock outcrop about 500 feet below gage.

EXTREMES OF DISCHARGE.—Maximum open-water stage during year, from water-stage recorder, 12.52 feet at 9 a. m. March 28 (discharge, from extension of rating curve, 10,600 second-feet); minimum stage from water-stage recorder, 2.96 feet at 6 a. m. October 18, and 7 a. m. November 1 (discharge 43 second-feet).

1909–1917: Maximum stage, determined by leveling from flood marks preserved on building near present gage, 17.31 feet, April 7, 1912 (discharge not determined); minimum stage from water-stage recorder, 1914-1917, 2.77 feet, August 13, 1914 and October 24, 1915 (discharge, 19 second-feet).

ICE.—Stage-discharge relation seriously affected by ice during the winter. Discharge ascertained by means of gage heights, current meter measurements, observer's notes, and weather records.

REGULATION.—Operation of power plants on main stream and tributaries above station cause large diurnal fluctuations in stage (see Water-Supply Paper 424, fig. 1, p. 41).

ACCURACY.—Stage-discharge relation practically permanent except when affected by ice. Rating curve well defined between 30 and 5,000 second-feet. Operation of water-stage recorder satisfactory during the year. Daily discharge determined by discharge integrator, except for high stages and during the period December to March, when mean daily gage heights were used. Open-water records good; winter records fair.

Discharge measurements of Winooski River at Montpelier, Vt., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 5	Hardin Thweatt	[a]4.96	316	Sept. 14	M. R. Stackpole	3.57	161
Feb. 17	H. H. Khachadoorian	[a]5.13	306	14	.....do	3.76	242
Mar. 13	.....do	[a]5.25	303	15	.....do	3.47	153
Apr. 1	C. H. Pierce	8.16	4,140				

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Winooski River at Montpelier, Vt., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	550	158	1,460	225	225	320	3,710	1,260	520	800	205	300
2	300	255	860	225	225	280	4,320	1,380	470	800	295	405
3	240	310	626	210	225	240	3,230	1,280	620	560	210	290
4	210	335	470	195	225	180	2,810	1,060	1,010	420	170	255
5	172	230	748	180	240	225	2,480	960	630	365	144	200
6	160	240	1,100	320	225	195	2,700	930	500	335	194	190
7	140	215	790	240	168	180	3,290	880	480	310	166	220
8	85	205	602	210	180	180	2,280	850	1,060	285	138	200
9	122	198	530	195	240	168	1,780	770	1,290	260	350	120
10	146	205	678	195	180	168	1,420	790	1,180	255	660	150
11	160	210	542	180	155	155	1,240	760	3,160	260	310	130
12	132	138	500	131	131	195	1,180	980	6,140	455	205	150
13	152	184	420	131	131	168	1,160	900	2,250	475	230	120
14	114	196	345	195	143	180	1.160	800	1,460	330	210	150
15	130	210	320	895	155	180	1,060	760	1,260	300	220	140
16	160	215	320	685	155	180	1,040	630	1,100	305	225	92
17	164	210	345	560	131	195	1,120	580	1,300	275	460	172
18	162	200	280	395	143	195	1,540	560	2,610	260	860	154
19	166	172	280	280	195	210	2,100	540	1,420	265	385	130
20	440	260	280	280	168	168	3,110	660	1,000	450	350	142
21	890	240	300	260	168	180	3,830	620	880	315	670	255
22	520	210	300	260	168	168	3,710	500	720	220	400	235
23	320	190	320	280	168	195	2,990	610	610	275	280	108
24	260	1,760	280	225	155	320	2,250	760	750	205	245	174
25	225	1,080	280	225	120	860	1,650	630	780	200	350	140
26	215	420	280	225	180	1,680	1,480	710	570	172	205	140
27	205	380	260	210	195	5,510	1,360	650	540	148	225	166
28	200	340	260	225	345	9,010	1,360	540	440	140	184	162
29	110	370	240	240	....	2,990	1,280	670	700	68	205	160
30	154	1,680	240	225	....	1.930	1,320	890	1,420	170	320	134
31	190	....	225	210	....	1,780	....	670	....	190	310	....

NOTE.—Stage-discharge relation affected by ice Dec. 14 to Mar. 26; discharge determined from a study of weather records, observed gage heights, and 3 discharge measurements. Discharge estimated Aug. 14–15 and Sept. 10–12.

Monthly discharge of Winooski River at Montpelier, Vt., for the year ending Sept. 30, 1917.

[Drainage area, 420 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	890	85	232	0.552	0.64
November	1,760	138	367	.874	.98
December	1,460	225	467	1.11	1.28
January	895	131	275	.655	.76
February	345	131	184	.438	.46
March	9,010	155	922	2.20	2.54
April	4,320	1,040	2,130	5.07	5.66
May	1,380	540	793	1.89	2.18
June	6,140	440	1,230	2.93	3.27
July	800	68	318	.757	.87
August	860	138	303	.721	.83
September	405	92	179	.426	.48
The year	9,010	68	616	1.47	19.96

DOG RIVER AT NORTHFIELD, VT.

Location.—At highway bridge near Norwich University campus in Northfield, Washington County. Union Brook joins Dog River a short distance below station.

Drainage area.—47 square miles (from surveys made by Norwich University students).

Records available.—May 14, 1909, to September 30, 1917. Records from May 14, 1909, to August 22, 1910, obtained at lower highway bridge; those from August 23, 1910, to date at present location.

Gages.—Gurley 7-day water-stage recorder; gage heights referred to gage datum by means of a hook gage inside the well; outside staff gage used for auxiliary readings.

Discharge measurements.—Made from highway bridge or by wading.

Channel and control.—Channel composed of gravel and alluvial deposits; subject to slight shifts.

Extremes of discharge.—Maximum stage during year, from water-stage recorder, 5.78 feet at 12.30 a. m. March 28 (discharge, 1,440 second-feet); minimum stage during year, from water-stage recorder, 0.92 foot several times in August and September (discharge, 7.8 second-feet).

1910–1917: Maximum stage recorded at present site, 8.5 feet March 25, 1913 (discharge, 3,400 second-feet); minimum stage recorded, 0.60 foot September 10 and 11, 1913 (discharge, 3.0 second-feet). At the lower gage, 1909–10 flow was practically zero at various times when water was held back by dam above gage.

Ice.—River frozen over during winter.

Accuracy.—Stage-discharge relation fairly permanent except when affected by ice. Rating curve well defined below 500 second-feet and poorly defined above. Operation of water-stage recorder satisfactory throughout year except for periods as shown in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage height obtained by inspecting gage-height graph. Records good, except those from November to March, which are estimated as stated in footnote to monthly-discharge table.

Discharge measurements of Dog River at Northfield, Vt., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 6	Hardin Thweatt	1.68	44.9	Apr. 2	C. H Pierce	4.12	560
Feb. 16	H. H. Khachadoorian	[a] 1.45	27.0	Sept. 15	M. R. Stackpole	1.04	12.8

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Dog River at Northfield, Vt., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	22	22		495	215	88	85	15	28
2	17	28		570	235	78	90	15	31
3	15	33		415	225	91	68	14	24
4	14	30		402	187	95	58	13	20
5	13	25		378	168	63	50	11	20
6	13	24		378	165	58	47	10	21
7	13	22		365	169	65	40	11	21
8	12	22		285	166	108	37	10	19
9	14	22		243	166	158	35	50	19
10	15	26		201	158	158	35	34	18
11	14	20		179	152	390	33	12	20
12	13	18	29	175	151	680	58	11	14
13	13	16	28	172	144	278	43	14	14
14	20	18	29	183	130	235	38	12	14
15	15		29	179	116	186	35	15	13
16	13		30	170	98	172	34	109	14
17	14		32	203	86	207	28	108	12
18	14		31	275	79	217	30	62	10
19	18		31	390	78	182	36	37	9
20	78		32	555	88	127	34	30	17
21	66		31	602	77	108	26	41	18
22	35		32	555	79	90	23	33	14
23	27		37	465	100	74	24	28	12
24	23		39	365	100	97	22	34	11
25	22		147	275	102	83	20	33	10
26	20		234	241	104	69	19	25	9
27	20		255	265	92	46	18	22	10
28	19		700	226	79	51	18	20	10
29	18		365	215	118	52	16	25	11
30	18		285	225	140	50	26	27	14
31	18		275		102		19	25	

NOTE.—Stage-discharge relation affected by ice during winter. Operation of water-stage recorder unsatisfactory Nov. 15 to Mar. 11; daily discharge not determined. Discharge estimated Mar. 16, Apr. 22–24, 27–30, May 1, June 13, 20, July 1, 23, and Aug. 9–12.

Monthly discharge of Dog River at Northfield, Vt., for the year ending Sept. 30, 1917.

[Drainage area, 47 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	78	12	20.8	0.443	0.51
November			a 42	.894	1.00
December			a 53	1.13	1.30
January			a 44	.936	1.08
February			a 33	.702	.73
March	700		a 100	2.13	2.46
April	602	170	321	6.83	7.62
May	235	77	132	2.81	3.24
June	680	46	146	3.11	3.47
July	90	16	36.8	.783	.90
August	109	10	29.3	.623	.72
September	31	9	15.9	.338	.38
The year	700		80.9	1.72	23.41

a Estimated.

NOTE.—Mean discharge, Nov. 15 to Mar. 11, estimated from a comparative study of two discharge measurements, and records of flow for White and Winooski rivers.

LAMOILLE RIVER AT CADYS FALLS, VT.

LOCATION.—About one-fourth mile below power house of Morrisville municipal electric plant, at what was formerly known as Cadys Falls, 2 miles downstream from Morrisville, Lamoille County.

DRAINAGE AREA.—280 square miles.

RECORDS AVAILABLE.—September 4, 1913 to September 30, 1917. A station was maintained at highway bridge near power plant at Cadys Falls from July 28, 1909, to July 13, 1910.

GAGES.—Barrett & Lawrence water-stage recorder in gage house on right bank, one-fourth mile below highway bridge at Cadys Falls, used to December 28, 1916; Friez water-stage recorder after December 29, 1916. Gage heights are referred to gage datum by means of a hook gage inside the well. An outside staff gage is used for auxiliary readings. From July 28, 1909, to July 13, 1910, chain gage on highway bridge was used.

DISCHARGE MEASUREMENTS.—Made from a cable or by wading.

CHANNEL AND CONTROL.—Bed smooth gravel. Well-defined gravel control 500 feet downstream from gage.

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder, 8.36 feet at 9.30 a. m. June 12 (discharge, 4,520 second-feet); minimum stage during year, from water-stage recorder, 1.95 feet at 3 a. m. Sept. 18 (discharge, 74 second-feet).

1913–1917: Maximum stage recorded, 10.53 feet April 20, 1914, (discharge 7,250 second-feet); minimum stage recorded, 1.82 feet, August 17, 1914 (discharge, 50 second-feet).

ICE.—River freezes over for short periods during extremely cold weather; stage-discharge relation slightly affected by ice.

ACCURACY.—Stage-discharge relation practically permanent, except when affected by ice. Rating curve well defined. Operation of water-stage recorder satisfactory throughout year except for short periods as shown in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage height obtained by inspecting gage-height graph, October 1 to April 30; by discharge integrator after May 1. Records good.

Discharge measurements of Lamoille River at Cadys Falls, Vt., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 29	Hardin Thweatt	a 2.43	190	July 23	M. R. Stackpole	3.94	895
Mar. 10	H. H. Khachadoorian	a 2.72	198				

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Lamoille River at Cadys Falls, Vt., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	533	118	1,520	200	250	250	2,260	1,000	305	900	435	405
2	302	343	770	195	240	300	3,420	1,060	415	960	550	465
3	230	339	560	195	200	290	2,680	1,020	410	660	590	550
4	191	359	428	195	180	250	2,100	800	510	430	420	435
5	163	313	614	210	205	260	1,880	600	450	310	295	360
6	153	272	972	244	200	230	1,800	610	350	300	230	340
7	132	244	745	251	195	220	2,430	600	300	200	220	360
8	112	188	551	276	210	200	1,590	560	385	182	205	390
9	144	175	471	265	250	185	1,090	530	440	215	630	220
10	156	211	614	276	250	185	820	550	415	240	700	215
11	147	191	462	287	200	170	720	700	1,140	220	440	240
12	156	163	416	268	200	210	672	960	3,420	255	360	210
13	156	178	347	248	200	205	636	760	1,340	285	325	192
14	258	163	262	258	190	205	632	610	840	580	290	196
15	230	166	279	770	180	190	587	540	730	450	325	180
16	211	188	251	628	180	185	596	440	620	400	320	174
17	194	172	237	551	205	190	632	385	640	350	1,290	162
18	191	224	240	445	180	175	1,180	345	1,860	310	1,520	116
19	198	220	220	420	190	200	1,800	330	1,080	410	710	154
20	484	244	240	403	200	185	2,770	390	1,060	475	640	240
21	870	220	220	324	170	150	3,620	410	870	540	920	285
22	551	220	220	336	140	190	3,420	330	590	1,140	650	180
23	359	309	207	320	140	190	2,680	370	460	820	385	150
24	330	1,950	201	290	135	570	1,840	510	520	500	420	162
25	302	945	210	276	105	870	1,320	295	600	330	670	200
26	273	672	205	268	135	1,060	1,150	310	460	275	480	178
27	244	367	200	262	140	2,020	895	360	385	250	390	162
28	172	347	230	214	180	3,620	795	310	320	210	335	186
29	121	367	200	258	....	2,100	972	350	455	200	490	206
30	129	1,590	200	262	....	1,320	1,060	520	1,000	620	620	225
31	115	....	200	262	....	1,060	....	370	....	530	570	....

NOTE.—Stage-discharge relation affected by ice Dec. 18–22, 25–31, Jan. 1–5, and Feb. 1 to Mar. 23; discharge determined from a study of weather records, recorded gage heights, and 2 discharge measurements. Discharge estimated Oct. 24–26 and July 14–16, 20.

Monthly discharge of Lamoille River at Cadys Falls, Vt., for the year ending Sept. 30, 1917.

[Drainage area, 280 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	533	112	252	0.900	1.04
November	1,590	118	382	1.36	1.52
December	1,520	200	403	1.44	1.66
January	770	195	312	1.11	1.28
February	250	105	188	.671	.70
March	3,620	150	562	2.01	2.32
April	3,620	587	1,600	5.71	6.37
May	1,060	295	546	1.95	2.25
June	3,420	300	745	2.66	2.97
July	1,140	182	440	1.57	1.81
August	1,520	205	530	1.89	2.18
September	550	116	252	.900	1.00
The year	3,620	105	518	1.85	25.10

GREEN RIVER AT GARFIELD, VT.

LOCATION.—At site of old dam above highway bridge at Garfield village, town of Hyde Park, Lamoille County. Green River is tributary to Lamoille River about 4 miles east of Morrisville.

DRAINAGE AREA.—20 square miles (roughly approximate).

RECORDS AVAILABLE.—January 3, 1915, to September 30, 1917.

GAGE.—Inclined staff on left bank in pool back of weir; read by P. M. Trescott.

DISCHARGE MEASUREMENTS.—Standard sharp-crested weir of compound section length of crest at gage height 0.00 is 9.0 feet; at gage height 0.83 foot, length of crest is increased 11.17 feet. Current-meter measurements made at footbridge about one-half mile downstream from weir, and at highway bridge about one-half mile above weir.

CHANNEL AND CONTROL.—A pool of considerable size is formed in the old mill pond back of the weir; at ordinary stages the velocity of approach to the weir is very small. Some water leaks around the weir in the old tail-race on left bank.

EXTREMES OF DISCHARGE.—Maximum stage during year, 3.12 feet at 9 a. m. April 22 (discharge, from extension of rating curve about 325 second-feet); minimum stage during year, 0.45 foot several times in February (discharge, 9.3 second-feet).

1915–1917: Maximum stage recorded, 3.6 feet at 9 a. m. April 22, 1915 (discharge from extension of rating curve, about 435 second-feet); minimum stage recorded, 0.35 foot at 9 a. m. February 5, 1915 (discharge, 6.3 second-feet). Rating curve revised since publication of report for 1916.

ICE.—Weir and weir crest kept clear of ice by clear fall below; stage-discharge relation not affected by ice.

REGULATION.—An old timber dam about 2 miles upstream affects flow to some extent. The dam leaks by an amount somewhat greater than the low-water flow. During prolonged low stages the surface of water in pond (103 acres) falls below crest of dam; subsequent increased flow into pond is retained until water again flows over crest, when the increased flow is apparent at gaging station.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve based on weir formula, $Q=3.33\ LH^{3/2}$, with corrections determined from current-meter measurements, and with logarithmic extension above gage height 1.90 feet. Gage read twice daily to hundredths. Daily discharge ascertained by applying mean daily gage height to rating table. Records good below 130 second-feet; at the higher stages the weir is flooded and records are somewhat uncertain.

COOPERATION.—Gage-height records furnished by C. T. Middlebrook, consulting engineer, Albany, N. Y.

Discharge measurements of Green River at Garfield, Vt., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
July 21	M. R. Stackpole........	1.60	[a] 89	July 21	Hardin Thweatt.......	1.59	[b] 86

[a] Measured at footbridge one-half mile below gage.
[b] Measured at old highway bridge one-half mile above gage.

Daily discharge, in second-feet, of Green River at Garfield, Vt., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	12	16	139	12	12	9.7	98	104	24	68	35	35
2	12	16	76	12	12	9.7	156	101	20	76	34	36
3	12	19	51	13	12	10	172	89	21	62	51	36
4	11	23	32	13	11	10	148	73	20	42	41	35
5	11	21	37	13	12	10	136	65	19	29	33	34
6	11	18	75	13	11	10	128	60	17	23	30	33
7	11	16	67	12	11	11	146	55	17	19	27	32
8	11	15	47	12	12	11	116	53	20	17	25	28
9	11	14	35	13	12	11	88	49	22	16	60	26
10	11	15	42	12	11	12	62	48	20	16	116	26
11	11	14	35	11	11	12	54	60	75	14	76	24
12	10	14	30	11	10	11	47	83	208	19	43	23
13	11	14	26	12	10	12	40	74	112	16	34	22
14	13	13	24	17	10	11	36	55	77	19	32	18
15	11	13	22	19	10	12	35	44	79	78	30	12
16	12	13	19	15	9.7	12	34	35	50	72	28	12
17	12	12	19	16	9.7	12	38	30	61	47	51	12
18	11	12	17	16	9.7	12	69	28	95	34	110	12
19	12	13	16	16	9.3	12	142	26	74	29	77	12
20	16	13	16	16	9.3	12	234	27	85	79	64	14
21	27	12	16	16	9.3	13	294	27	114	86	51	14
22	40	11	16	15	9.3	13	318	24	67	132	44	13
23	30	14	16	14	9.3	14	272	27	47	115	38	13
24	22	75	16	14	9.3	18	198	30	45	54	35	13
25	19	92	16	13	9.3	17	117	30	45	36	44	12
26	17	43	15	13	9.3	22	109	35	34	29	41	12
27	16	32	15	12	10	34	95	31	29	25	37	12
28	15	30	14	13	10	97	96	27	25	27	34	14
29	14	32	13	13	....	104	104	26	32	30	39	13
30	13	85	12	12	....	83	108	30	64	35	37	16
31	13	....	12	12	....	75	....	27	....	38	37	....

Monthly discharge, in second-feet, of Green River at Garfield, Vt., for the year ending Sept. 30, 1917.

Month.	Maximum.	Minimum.	Mean.
October	40	10	14.8
November	92	11	24.3
December	139	12	31.8
January	19	11	13.6
February	12	9.3	10.4
March	104	9.7	23.0
April	318	34	123
May	104	24	47.5
June	208	17	54.4
July	132	14	44.6
August	116	25	46.3
September	36	12	20.5
The year	318	9.3	37.9

MISSISQUOI RIVER NEAR RICHFORD, VT.

Location.—About 3 miles downstream from Richford, Franklin County, 3 miles below mouth of North Branch and 2 miles above mouth of Trout River.

Drainage area.—445 square miles.

Records available.—May 22, 1909, to December 3, 1910, and June 26, 1911, to September 30, 1917.

Gage.—Gurley graph water-stage recorder in gage house on left bank, about one-fourth mile above highway bridge; chain gage on highway bridge used June 26, 1911, to July 31, 1915. From May 22, 1909, to December 3, 1910, gage was just below plant of the Sweat-Comings Co. in Richford.

Discharge measurements.—Made from highway bridge or by wading.

Channel and control.—Channel deep; banks not subject to overflow; stream bed composed of gravel, boulders, and ledge rock. Control is sharply defined by rock outcrop about 100 feet below gage.

Extremes of discharge.—Maximum stage during year, from water-stage recorder, 11.53 feet at 5 a. m. April 3 (discharge, 8,690 second-feet); minimum stage, from water-stage recorder, 2.77 feet at 6 a. m. September 28 (discharge, 191 second-feet).

1911–1917: Maximum stage recorded, 16.7 feet by chain gage March 26, 1913 (determination of discharge, 10,200 second-feet, from extension of rating curve may be subject to error); minimum stage recorded, 4.15 feet by chain gage, July 14, 1911 (discharge, 8 second-feet).

Ice.—Stage-discharge relation seriously affected by ice; discharge determined from gage heights corrected for backwater by means of current-meter measurements, observer's notes, and weather records.

Regulation.—Considerable daily fluctuation at low stages caused by operation of power plants at Richford.

Accuracy.—Stage-discharge relation changed slightly, presumably when ice went out March 27. Rating curve fairly well defined below 6,000 second-feet. Operation of water-stage recorder satisfactory during the year except for occasional short periods. Daily discharge ascertained by applying to rating table mean daily gage height determined by inspection of recorder sheets; determinations for periods for which no record was obtained, are based on comparison with records of flow of streams in adjacent drainage basins. Results good for periods when water-stage recorder was in operation, and fair for other periods and during the winter.

Discharge measurements of Missisquoi River near Richford, Vt., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 3	Hardin Thweatt	3.80	644	Apr. 2	H. H. Khachadoorian	9.30	5,970
Dec. 31	do	a 4.83	381	July 25	Hardin Thweatt	3.65	486
Mar. 9	H. H. Khachadoorian	a 4.50	288	26	M. R. Stackpole	3.57	417

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Missisquoi River near Richford, Vt., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,350	545	3,740	360	430	460	4,050	2,100	640	2,240	296	585
2	900	700	2,140	360	410	520	5,880	2,540	600	1,880	314	600
3	668	720	1,600	310	360	490	8,000	2,440	625	1,200	391	680
4	488	732	960	310	360	460	6,480	1,840	1,170	770	339	536
5	418	668	1,450	310	360	430	5,160	1,480	950	575	268	407
6	350	575	1,800	360	360	410	4,380	1,280	710	487	225	391
7	292	521	1,250	520	360	380	4,600	1,240	650	415	200	398
8	250	488	1,000	460	380	360	4,050	1,170	600	363	200	355
9	258	488	860	410	430	310	2,740	1,140	650	335	363	307
10	327	830	1,050	360	430	280	1,920	1,170	1,500	350	1,170	488
11	322	830	840	310	410	280	1,440	2,200	2,150	298	800	455
12	292	420	760	310	360	360	1,360	2,840	6,120	300	482	383
13	341	440	640	310	340	360	1,360	2,060	4,600	375	359	332
14	1,740	440	580	360	310	360	1,240	1,560	2,540	383	307	300
15	1,390	440	490	1,500	310	340	1,140	1,520	2,440	428	318	276
16	935	450	460	1,250	310	340	1,140	1,200	1,720	469	545	359
17	935	460	460	980	360	340	1,140	960	1,440	375	1,640	367
18	970	480	430	840	310	340	1,640	925	1,920	424	2,640	304
19	935	488	410	760	310	340	2,440	890	1,880	1,720	1,520	279
20	2,060	557	410	700	360	340	3,720	1,000	1,030	1,640	1,600	960
21	3,130	510	410	660	310	310	5,040	1,050	1,320	960	1,640	1,100
22	2,530	466	380	640	270	360	6,240	900	960	1,060	1,060	770
23	1,600	521	380	580	250	520	6,240	1,030	680	1,030	740	492
24	1,150	3,130	360	540	250	1,050	4,820	1,200	565	710	585	391
25	970	3,330	360	520	230	1,500	2,840	1,280	570	585	565	328
26	865	1,350	360	490	230	1,800	2,100	1,240	496	455	555	300
27	798	1,230	360	460	310	3,300	1,760	1,060	460	371	433	282
28	732	1,110	360	410	410	5,600	1,640	830	424	318	367	293
29	635	1,190	360	460	....	3,200	1,720	740	469	282	355	375
30	575	3,530	360	460	....	3,200	1,920	740	1,600	307	514	460
31	521	....	360	430	....	3,390	....	710	....	314	710	....

NOTE.—Stage-discharge relation affected by ice from about Dec. 15 to Mar. 27. Discharge computations for this period based on gage heights corrected for effect of ice by means of two discharge measurements, observer's notes, and weather records. Discharge estimated during periods of open water as follows: Oct. 1, Nov. 3, 12–18, Dec. 3–14, Mar. 28–30, May 20–22, June 5, 7–10, July 10, Aug. 6–8.

Monthly discharge of Missisquoi River near Richford, Vt., for the year ending Sept. 30, 1917.

[Drainage area 445 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	3,130	250	926	2.08	2.40
November	3,530	420	921	2.07	2.31
December	3,740	360	819	1.84	2.12
January	1,500	310	540	1.21	1.40
February	430	230	340	.764	.80
March	5,600	280	1,020	2.29	2.64
April	8,000	1,140	3,270	7.35	8.20
May	2,840	710	1,370	3.08	3.55
June	6,120	424	1,380	3.10	3.46
July	2,240	282	691	1.55	1.79
August	2,640	200	694	1.56	1.80
September	1,100	282	452	1.02	1.14
The year	8,000	200	1,040	2.34	31.61

CLYDE RIVER AT WEST DERBY, VT.

LOCATION.—Just below plant of Newport Electric Light Co. at West Derby (Newport), Orleans County; about 1 mile above mouth of river.

DRAINAGE AREA.—150 square miles.

RECORDS AVAILABLE.—May 25, 1909, to September 30, 1917.

GAGES.—Barrett & Lawrence water-stage recorder on right bank used to March 8, 1917, when a Stevens 8-day water-stage recorder was installed; chain gage fastened to tree is used for auxiliary readings; gage heights referred to chain-gage datum.

DISCHARGE MEASUREMENTS.—Made by wading near gage, or from highway bridge half a mile downstream.

CHANNEL AND CONTROL.—Stream bed rough and irregular; covered with boulders and ledge rock; fall of river rapid for some distance below gage.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 3.90 feet at 3 a. m. April 25 (discharge, 1,370 second-feet); minimum stage during year from chain gage 1.98 feet at 8.20 a. m. March 20 (discharge, 86 second-feet).

ICE.—Ice covers large boulders below gage during greater part of winter and causes some backwater.

REGULATION.—Flow at ordinary stages fully controlled by two dams at West Derby, but power plant is so operated that fluctuations in stage are not great. Distribution of flow affected also by several dams above West Derby. Seymour Lake and several smaller ponds in the basin afford a large amount of natural storage, but at the present time there is little if any artificial regulation at these ponds.

ACCURACY.—Stage-discharge relation practically permanent except when affected by ice; individual current-meter measurements occasionally plot erratically, probably because of rough measuring section. Rating curve fairly well defined. Operation of water-stage recorder unsatisfactory during a part of the year on account of clock stopping, as indicated in footnote to daily-discharge table. Daily discharge ascertained by applying mean daily gage heights to rating table, using observer's reading of chain gage when recorder was not in operation (chain-gage readings to quarter-tenths twice daily). Records fair.

Discharge measurements of Clyde River at West Derby, Vt., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height, in feet.		Discharge.	Date.	Made by—	Gage height in feet.		Discharge.
		Hook gage.	Chain gage.				Hook gage.	Chain gage.	
				Sec.-ft.					*Sec.-ft.*
Oct. 4	Hardin Thweatt.	2.57	2.53	254	Apr. 3	H. H. Khachadoorian........	3.48	3.48	886
4	.....do...........	2.57	2.53	247	July 24	M. R. Stackpole..	2.61	2.46	234
Jan. 1	.....do...........	a2.40	a2.40	170	24	Hardin Thweatt.	2.61	2.46	219
Mar. 8	H. H. Khachadoorian........	2.60	2.15	124					

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Clyde River at West Derby, Vt., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	170	140	360	145	110	120	500	755	290	172	127	387
2	197	140	390	120	110	155	710	755	280	165	127	404
3	218	145	435	105	110	115	850	800	280	159	138	336
4	221	150	420	110	110	120	900	800	260	150	144	295
5	214	155	400	135	115	115	900	755	240	130	162	260
6	182	155	387	155	110	110	900	665	232	115	165	260
7	158	150	375	146	105	102	900	580	228	110	153	270
8	138	146	350	140	100	115	850	540	216	105	144	210
9	135	145	320	140	100	120	755	540	204	105	209	140
10	120	140	305	135	95	120	665	500	216	110	228	140
11	115	140	315	130	95	95	580	460	228	115	216	145
12	110	135	298	128	90	105	540	500	264	125	220	120
13	122	135	265	130	90	95	460	540	268	150	236	115
14	160	140	255	140	90	90	432	580	310	180	282	100
15	102	146	245	195	85	112	411	580	348	205	228	90
16	110	140	240	155	85	110	390	540	336	200	204	90
17	120	135	230	155	80	95	378	500	378	180	286	80
18	125	130	230	150	80	102	404	453	460	165	272	80
19	128	128	220	140	80	90	432	425	425	195	300	85
20	143	140	220	135	80	86	540	397	418	215	360	100
21	173	120	210	130	80	100	665	384	397	230	411	110
22	197	115	205	125	80	90	950	366	354	240	418	110
23	207	105	205	120	80	90	1,180	372	315	240	378	95
24	218	205	205	120	80	110	1,370	360	272	244	360	90
25	228	215	205	115	85	130	1,370	354	285	236	384	85
26	214	243	200	110	90	155	1,240	348	300	228	418	85
27	194	255	195	110	95	210	1,060	354	272	196	425	80
28	182	275	185	110	110	364	900	325	244	175	432	75
29	170	284	180	110	....	449	800	320	200	162	453	80
30	155	350	175	110	....	505	755	310	179	150	445	100
31	145	....	175	110	....	505	....	300	....	133	429	....

NOTE.—Stage-discharge relation affected by ice Dec. 13 to Jan. 4 and Jan. 17 to Feb. 26; discharge determined from a study of weather records, recorded gage heights, and 1 discharge measurement. Discharge July 4–23 and Sept. 6–30 estimated by comparison with records for nearby streams.

Monthly discharge of Clyde River at West Derby, Vt., for the year ending Sept. 30, 1917.

[Drainage area 150 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	228	100	162	1.08	1.24
November	350	105	167	1.11	1.24
December	435	175	271	1.81	2.09
January	195	105	131	.873	1.01
February	115	80	93.6	.624	.65
March	505	86	157	1.05	1.21
April	1,370	378	760	5.07	5.66
May	800	300	499	3.33	3.84
June	460	179	290	1.93	2.15
July	244	105	170	1.13	1.30
August	453	127	279	1.86	2.14
September	404	75	155	1.03	1.15
The year	1,370	75	262	1.75	23.68

INDEX.

STREAM-GAGING STATIONS

AND

PUBLICATIONS RELATING TO WATER RESOURCES

PART IV. ST. LAWRENCE RIVER BASIN

STREAM-GAGING STATIONS AND PUBLICATIONS RELATING TO WATER RESOURCES.

INTRODUCTION.

Investigation of water resources by the United States Geological Survey has consisted in large part of measurements of the volume of flow of streams and studies of the conditions affecting that flow, but it has comprised also investigations of such closely allied subjects as irrigation, water storage, water powers, underground waters, and quality of waters. Most of the results of these investigations have been published in the series of water-supply papers, but some have appeared in the bulletins, professional papers, monographs, and annual reports.

The results of stream-flow measurements are now published annually in 12 parts, each part covering an area whose boundaries coincide with natural drainage features, as indicated below:

Part I. North Atlantic slope basins.
II. South Atlantic slope and eastern Gulf of Mexico basins.
III. Ohio River basin.
IV. St. Lawrence River basin.
V. Upper Mississippi River and Hudson Bay basins.
VI. Missouri River basin.
VII. Lower Mississippi River basin.
VIII. Western Gulf of Mexico basins.
IX. Colorado River basin.
X. Great Basin.
XI. Pacific slope basins in California.
XII. North Pacific slope basins, in three volumes:
A. Pacific slope basins in Washington and upper Columbia River basin.
B. Snake River basin.
C. Lower Columbia River basin and Pacific slope basins in Oregon.

HOW GOVERNMENT REPORTS MAY BE OBTAINED OR CONSULTED.

Water-supply papers and other publications of the United States Geological Survey containing data in regard to the water resources of the United States may be obtained or consulted as indicated below:

1. Copies may be obtained free of charge by applying to the Director of the Geological Survey, Washington, D. C. The edition printed for free distribution is, however, small and is soon exhausted.

2. Copies may be purchased at nominal cost from the Superintendent of Documents, Government Printing Office, Washington, D. C., who will on application furnish list giving prices.

3. Sets of the reports may be consulted in the libraries of the principal cities in the United States.

4. Complete sets are available for consultation in the local offices of the water-resources branch of the Geological Survey, as follows:

Boston, Mass., 2500 Customhouse.
Albany, N. Y., 704 Journal Building.
Atlanta, Ga., Post Office Building.
Chicago, Ill., 1404 Kimball Building.
Madison, Wis., care of Railroad Commission of Wisconsin.
Helena, Mont., Montana National Bank Building.
Denver, Colo., 403 New Post Office Building.
Topeka, Kans., Room 25, Federal Building.
Salt Lake City, Utah, 421 Federal Building
Boise, Idaho, 615 Idaho Building.
Tucson, Ariz., University of Arizona.
Austin, Tex., Capitol Building.
Portland, Oreg., 606 Post Office Building.
Tacoma, Wash., 406 Federal Building.
San Francisco, Calif., 328 Customhouse.
Los Angeles, Calif., 619 Federal Building.
Honolulu, Hawaii, 14 Capitol Building.

A list of the Geological Survey's publications may be obtained by applying to the Director of the United States Geological Survey, Washington, D. C.

STREAM-FLOW REPORTS.

Stream-flow records have been obtained at more than 4,240 points in the United States, and the data obtained have been published in the reports tabulated below:

Stream-flow data in reports of the United States Geological Survey.

[A=Annual Report; B=Bulletin; W=Water-Supply Paper.]

Report.	Character of data.	Year.
10th A, pt. 2	Descriptive information only	
11th A, pt. 2	Monthly discharge and descriptive information	1884 to September, 1890.
12th A, pt. 2	do	1884 to June 30, 1891.
13th A, pt. 3	Mean discharge in second-feet	1884 to Dec. 31, 1892.
14th A, pt. 2	Monthly discharge (long-time records, 1871 to 1893)	1888 to Dec. 31, 1893.
B 131	Descriptions, measurements, gage heights, and ratings	1893 and 1894
16th A, pt. 2	Descriptive information only	
B 140	Descriptions, measurements, gage heights, ratings, and monthly discharge (also many data covering earlier years).	1895.
W 11	Gage heights (also gage heights for earlier years)	1896.
18th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge (also similar data for some earlier years).	1895 and 1896.
W 15	Descriptions, measurements, and gage heights, eastern United States, eastern Mississippi River, and Missouri River above junction with Kansas.	1897.

Stream-flow data in reports of the United States Geological Survey—Continued.

Report.	Character of data.	Year.
W 15	Descriptions, measurements, and gage heights, western Mississippi River below junction of Missouri and Platte, and western United States.	1897.
19th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge (also some long-time records).	1897.
W 27	Measurements, ratings, and gage heights, eastern United States, eastern Mississippi River, and Missouri River.	1898.
W 28	Measurements, ratings, and gage heights, Arkansas River and western United States.	1898.
20th A, pt. 4	Monthly discharge (also for many earlier years)	1898.
W 35 to 39	Descriptions, measurements, gage heights, and ratings	1899.
21st A, pt. 4	Monthly discharge	1899.
W 47 to 52	Descriptions, measurements, gage heights, and ratings	1900.
22d A, pt. 4	Monthly discharge	1900.
W 65, 66	Descriptions, measurements, gage heights, and ratings	1901.
W 75	Monthly discharge	1901.
W 82 to 85	Complete data	1902.
W 97 to 100	do	1903.
W 124 to 135	do	1904.
W 165 to 178	do	1905.
W 201 to 214	do	1906.
W 241 to 252	do	1907–8.
W 261 to 272	do	1909.
W 281 to 292	do	1910.
W 301 to 312	do	1911.
W 321 to 332	do	1912.
W 351 to 362	do	1913.
W 381 to 394	do	1914.
W 401 to 414	do	1915.
W 431 to 444	do	1916.
W 451 to 464	do	1917.

The records at most of the stations discussed in these reports extend over a series of years, and miscellaneous measurements at many points other than regular gaging stations have been made each year. An index of the reports containing records obtained prior to 1904 has been published in Water-Supply Paper 119.

The following table gives, by years and drainage basins, the numbers of the papers on surface-water supply published from 1899 to 1917. The data for any particular station will, as a rule, be found in the reports covering the years during which the station was maintained. For example, data for Machias River at Whitneyville, Me., 1903 to 1917, are published in Water-Supply Papers 97, 124, 165, 201, 241, 261, 281, 301, 321, 351, 381, 401, 431, and 451, which contain records for the New England streams from 1903 to 1917. Results of miscellaneous measurements are published by drainage basins.

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Numbers of water-supply papers containing results of stream measurements, 1899–1917.

Year.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII North Pacific slope basins.		
	North Atlantic slope (St. John River to York River).	South Atlantic and eastern Gulf of Mexico (James River to the Mississippi).	Ohio River basin.	St. Lawrence River and Great Lakes basins.	Hudson Bay and upper Mississippi River basins.	Missouri River basin.	Lower Mississippi River basin.	Western Gulf of Mexico basins.	Colorado River basin.	Great Basin.	Pacific slope basins in California.	Pacific slope basins in Washington and upper Columbia River.	Snake River basin.	Lower Columbia River and Pacific slope basins in Oregon.
1899[a]	35	[b] 35, 36	36	36	36	[c] 36, 37	37	37	[d] 37, 38	38, [e] 39	38, [f] 39	38	38	38
1900[g]	47, [h] 48	48	48, [i] 49	49	49	49, [j] 50	50	50	50	51	51	51	51	51
1901	65, 75	65, 75	65, 75	65, 75	[k] 65, 66, 75	66, 75	[k] 65, 66, 75	66, 75	66, 75	66, 75	66, 75	66, 75	66, 75	66, 75
1902	82	[b] 82, 83	83	[l] 82, 83	[k] 83, 85	84	[k] 82, 84	84	85	85	85	85	85	85
1903	97	[b] 97, 98	98	97	[k] 98, 99, [m] 100	99	[k] 98, 99	99	100	100	100	100	100	100
1904	[n] 124, [o] 125, [p] 126	[p] 126, 127	128	129	[k] 128, 130	130, [q] 131	[k] 128, 131	132	133	133, [r] 134	134	135	135	135
1905	[n] 165, [o] 166, [p] 167	[p] 167, 168	169	170	171	172	[k] 170, 173	174	175, [s] 177	176, [r] 177	177	178	178	[t] 177, 178
1906	[n] 201, [o] 202, [p] 203	[p] 203, 204	205	206	207	208	[k] 205, 209	210	211	212, [r] 213	213	214	214	214
1907–8	241	242	243	244	245	246	247	248	249	250, [r] 251	251	252	252	252
1909	261	262	263	264	265	266	267	268	269	270, [r] 271	271	272	272	272
1910	281	282	283	284	285	286	287	288	289	290	291	292	292	292
1911	301	302	303	304	305	306	307	308	309	310	311	312	312	312
1912	321	322	323	324	325	326	327	328	329	330	331	332A	332B	332C
1913	351	352	353	354	355	356	257	358	359	360	361	362A	362B	362C
1914	381	382	383	384	385	386	387	388	389	390	391	392	393	394
1915	401	402	403	404	405	406	407	408	409	410	411	412	413	414
1916	431	432	433	434	435	436	437	438	439	440	441	442	443	444
1917	451	452	453	454	455	456	457	458	459	460	461	462	463	464

[a] Rating tables and index to Water-Supply Papers 35–39 contained in Water-Supply Paper 39. Estimates for 1899 in Twenty-first Annual Report, Part IV.
[b] James River only.
[c] Gallatin River.
[d] Green and Gunnison rivers and Grand River above junction with Gunnison.
[e] Mohave River only.
[f] Kings and Kern rivers and south Pacific coast basins.
[g] Rating tables and index to Water-Supply Papers 47–52 and data on precipitation, wells, and irrigation in California and Utah contained in Water-Supply Paper 52. Estimates for 1900 in Twenty-second Annual Report, Part IV.
[h] Wissahickon and Schuylkill rivers to James River.
[i] Scioto River.
[j] Loup and Platte rivers near Columbus, Nebr., and all tributaries below junction with Platte.
[k] Tributaries of Mississippi from east.
[l] Lake Ontario and tributaries to St. Lawrence River proper.
[m] Hudson Bay only.
[n] New England Rivers only.
[o] Hudson River to Delaware River, inclusive.
[p] Susquehanna River to Yadkin River, inclusive.
[q] Platte and Kansas rivers.
[r] Great Basin in California, except Truckee and Carson river basins.
[s] Below junction with Gila.
[t] Rogue, Umpqua, and Siletz rivers only.

In these papers and in the following lists the stations are arranged in downstream order. The main stem of any river is determined by measuring or estimating its drainage area—that is, the headwater stream having the largest drainage area is considered the continuation of the main stream, and local changes in name and lake surface are disregarded. All stations from the source to the mouth of the main stem of the river are presented first, and the tributaries in regular order from source to mouth follow, the streams in each tributary basin being listed before those of the next basin below.

The exceptions to this rule occur in the records for Mississippi River, which are given in four parts, as indicated on page III, and in the records for the large lakes, where it is simpler to take up the streams in regular order around the rim of the lake than to cross back and forth over the lake surface.

Part IV. ST. LAWRENCE RIVER BASIN.

PRINCIPAL STREAMS.

The St. Lawrence River basin includes streams which drain into the Great Lakes and St. Lawrence River. The principal streams flowing directly or indirectly into Lake Superior from the United States are St. Louis, Ontonagon, Dead, and Carp rivers; streams flowing into Lake Michigan are Escanaba, Menominee, Peshtigo, Oconto, Fox, St. Joseph, and Grand rivers; into Lake Huron flow Thunder Bay, Au Sable, Rifle, and Saginaw rivers; into Lake Erie flow Huron, Maumee, Sandusky, Black, and Cuyahoga rivers. Streams flowing into Lake Ontario are Genesee, Oswego, Salmon, and Black rivers. The St. Lawrence receives Oswegatchie and Raquette rivers, Richelieu River (the outlet of Lake Champlain), and St. Francis River, whose principal tributary, Clyde River, reaches it through Lake Memphremagog. The streams of this basin drain wholly or in part the States of Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, Vermont, and Wisconsin.

In addition to the list of gaging stations and annotated list of publications relating specifically to the section, this part contains a similar list of reports that are of general interest in many sections and cover a wide range of hydrologic subjects, and also brief references to reports published by State and other organizations. (See p. XIX.)

GAGING STATIONS.

NOTE.—Dash following a date indicates that station was being maintained September 30, 1917. Period after date indicates discontinuance.

Streams tributary to Lake Superior:
- Brule River at mouth, Minn., 1911.
- Devil Track River at mouth, Minn., 1911.
- Cascade River at mouth, Minn., 1911.
- Poplar River at Lutsen, Minn., 1911–
- Beaver Bay River at Beaver Bay, Minn., 1911–1914.
- St. Louis River near Cloquet, Minn., 1903.
- St. Louis River near Thomson, Minn., 1909–1915.
  - Whiteface River at Meadowlands, Minn., 1909–1912.
  - Whiteface River below Meadowlands, Minn., 1912–
  - Cloquet River at Independence, Minn., 1909–
- Aminicon River near Aminicon Falls, Wis., 1914–1916.
- Brule River near Brule, Wis., 1914–
- Bad River near Odanah, Wis., 1914–
- Ontonagon River near Rockland, Mich., 1903.

Streams tributary to Lake Superior—Continued.
- Sturgeon River near Sidnaw, Mich., 1912–1915.
- Perch River near Sidnaw, Mich., 1912–1915.
- Dead River near Negaunee, Mich., 1902–3.
- Dead River at Forestville, Mich., 1898–1902.
- Carp River near Marquette, Mich., 1902–3.

Streams tributary to Lake Michigan:
- Escanaba River near Escanaba, Mich., 1903–1915.
- Brule River (head of Menominee River) near Florence, Wis., 1914–1916.
- Menominee River near Iron Mountain, Mich., 1902–1914.
- Menominee River at Lower Quinnesec Falls, Wis., 1898–99.
- Menominee River at Koss, Mich., 1902–1909; 1914.
- Menominee River below Koss, Mich., 1913–
  - Iron River near Iron River, Mich., 1900–1905.
  - Pine River near Florence, Wis., 1914–
  - Pike River at Amberg., Wis., 1914–
- Peshtigo River at High Falls, near Crivitz, Wis., 1912–
- Peshtigo River near Crivitz, Wis., 1906–1909.
- Peshtigo River at Crivitz, Wis., 1906.
- Oconto River near Gillett, Wis., 1906–1909; 1914–
- Oconto River at Stiles, Wis., 1906.
- Fox River at Omro, Wis., 1902–3.
- Fox River at Oshkosh, Wis., 1902.
- Fox River at Wrightstown, Wis., 1902–1904.
- Fox River at Rapide Croche dam, Wis., 1896–
  - Wolf River at Keshena, Wis., 1907–1909; 1911–
  - Wolf River at White House Bridge, near Shawano, Wis., 1906–7.
  - Wolf River at Darrows Bridge, near Shawano, Wis., 1906.
  - Wolf River at New London, Wis., 1913–
  - Wolf River at Northport, Wis., 1905.
  - Wolf River at Winneconne, Wis., 1902–3.
    - West Branch of Wolf River at Neopit, Wis., 1911–
    - Little Wolf River at Royalton, Wis., 1914–
    - Little Wolf River near Northport, Wis., 1907–1910.
    - Waupaca River near Weyauwega, Wis., 1916–
  - Fond du Lac River, West Branch (head of Fond du Lac River) at Fond du Lac, Wis., 1903.
  - East Branch of Found du Lac River at Fond du Lac, Wis., 1903.
- Sheboygan River near Sheboygan, Wis., 1916–
- Milwaukee River near Milwaukee, Wis., 1914–
- Little Calumet River at Harvey, Ill., 1916–
- St. Joseph River at Mendon, Mich., 1902–1905.
- St. Joseph River near Buchanan, Mich., 1901–1906.
  - Fawn River at White Pigeon, Mich., 1903–4.
- Kalamazoo River near Allegan, Mich., 1901–1907.
  - Reeds Springs near Albion, Mich., 1904–1906.
- Grand River at North Lansing, Mich., 1901–1906.
- Grand River at Grand Rapids, Mich., 1901–
  - Crockery Creek at Slocums Grove, Mich., 1902–3.
  - Red Cedar River at Agricultural College, Mich., 1902–3.
- Muskegon River at Newaygo, Mich., 1901–1906.
- Manistee River near Sherman, Mich., 1903–1916.
- Boardman River at Traverse City, Mich., 1904.

Streams tributary to Lake Huron:
- Thunder Bay River near Alpena, Mich., 1901–1908.
- Au Sable River near Lovells, Mich., 1908–1914.
- Au Sable River at Bamfield, Mich., 1902–1913.
- Rifle River near Sterling, Mich., 1905–1908.
- Rifle River at Omer, Mich., 1902–3.
- Shiawassee River (head of Saginaw River):
  - Flint River at Flint, Mich., 1903–4.
  - Cass River at Frankenmuth, Mich., 1908–9.
  - Cass River at Bridgeport, Mich., 1908.
  - Tittabawassee River at Freeland, Mich., 1903–1909; 1912–

Streams tributary to Lake Erie:
- Huron River at Dover, Mich., 1904.
- Huron River at Dexter, Mich., 1904–1916.
- Huron River at Barton, Mich., 1914–
- Huron River at Geddes, Mich., 1904–1914.
- Huron River at French Landing, Mich., 1904–5.
- Huron River at Flat Rock, Mich., 1904–
- Maumee River near Sherwood, Ohio, 1903–1906.
- Maumee River near Waterville, Ohio, 1898–1901.
  - St. Marys River at Fort Wayne, Ind., 1905–6.
  - St. Joseph River at Fort Wayne, Ind., 1905–6.
  - Tiffin River near Defiance, Ohio, 1903–1906.
  - Auglaize River near Defiance, Ohio, 1903.
    - Ottawa River at Lima, Ohio, 1902–3.
    - Blanchard River at Ottawa, Ohio, 1902–3.
- Sandusky River near Mexico, Ohio, 1898–1900.
- Sandusky River at Fremont, Ohio, 1898–1901.
- Black River near Elyria, Ohio, 1903–1906.
- Cuyahoga River at Independence, Ohio, 1903–1906.
- Cuyahoga River at Cleveland, Ohio, 1903.
- Cattaraugus Creek at Versailles, N. Y., 1910–

Streams tributary to Lake Ontario:
- Niagara River:
  - Tonawanda Creek:
    - Little Tonawanda Creek near Linden, N. Y., 1912–
- Genesee River at Scio, N. Y., 1916–
- Genesee River at St. Helena, N. Y., 1908–
- Genesee River at Mount Morris, N. Y., 1905–1909.
- Genesee River at Jones Bridge, near Mount Morris, N. Y., 1903–1906; 1908–1913; 1915–
- Genesee River at Rochester, N. Y., 1904–
  - Canaseraga Creek near Dansville, N. Y., 1910–1912; 1915–1917.
  - Canaseraga Creek at Groveland station, N. Y., 1915–
  - Canaserago Creek at Shakers Crossing, N. Y., 1915–
    - Keshequa Creek at Sonyea, N. Y., 1910–1912.
    - Keshequa Creek near Sonyea, N. Y., 1915–1917.
  - Hemlock Lake at Hemlock, N. Y., 1894–1902.
    - Canadice outlet near Hemlock, N. Y., 1903–
    - Honeoye Creek at East Rush, N. Y., 1903–1906.
- Seneca River (head of Oswego River) at Baldwinsville, N. Y., 1898–1908.
- Oswego River at Fulton, N. Y., 1900; 1902.
- Oswego River at Battle Island, above Minetto, N. Y., 1900–1906.

Streams tributary to Lake Ontario—Continued.
- Oswego River at high dam, near Oswego, N. Y., 1897-1901.
  - Seneca Lake at Geneva, N. Y., 1905-6.
  - Cayuga Lake at Ithaca, N. Y., 1905-1908.
    - Fall Creek near Ithaca, N. Y., 1908-9.
  - Owasco Lake outlet near Auburn, N. Y., 1912-
  - Skaneateles Lake at Skaneatleles, N. Y., 1890-91.
  - Skaneateles Lake outlet at Willow Glen, N. Y., 1892-1908.
  - Skaneateles Lake outlet at Jordan, N. Y., 1890-1892.
  - Onondaga Lake outlet at Long Branch, N. Y., 1904.
  - West Branch of Onondago Creek at South Onondaga, N. Y., 1916-
  - Fish Creek, East Branch (through Oneida Lake, head of Oneida River), at Point Rock, N. Y., 1898-99.
  - Oneida River at Brewerton, N. Y., 1899.
  - Oneida River at Oak Orchard, near Euclid, N. Y., 1902-1909.
  - Oneida River at Caughdenoy, N. Y., 1910-1913.
    - Fish Creek:
      - West Branch of Fish Creek at McConnellsville, N. Y., 1898-1901.
      - Oneida Creek at Kenwood, N. Y., 1898-1900.
      - Chittenango Creek at Chittenango, N. Y., 1901-1906.
      - Chittenango Creek at Bridgeport, N. Y., 1898-1901.
- Salmon River at Stillwater Bridge, near Redfield, N. Y., 1911-1913.
- Salmon River near Pulaski, N. Y., 1900-1908; 1910-1914.
  - Orwell Brook near Altmar, N. Y., 1911-1916.
- Black River near Boonville, N. Y., 1911-
- Black River near Felts Mills, N. Y., 1902-1913.
- Black River at Black River, N. Y., 1917-
- Black River at Huntingtonville dam, near Watertown, N. Y., 1897-1901.
  - Forestport feeder near Boonville, N. Y., 1915-
  - Black River canal flowing south near Boonville, N. Y., 1915-
  - Moose River at Moose River, N. Y., 1900-
    - Middle Branch of Moose River at Old Forge, N. Y., 1911-
  - Beaver River at State dam, near Beaver River, N. Y., 1908-
  - Beaver River at Croghan, N. Y., 1901-1903.

Streams tributary to the St. Lawrence:
- Oswegatchie River, East Branch (head of Oswegatchie River), at Newton Falls, N. Y., 1912-
- Oswegatchie River near Heuvelton, N. Y., 1916-
- Oswegatchie River near Ogdensburg, N. Y., 1903-1916.
  - West Branch of Oswegatchie River near Harrisville, N. Y., 1916-
- Raquette River at Raquette Falls, near Coreys, N. Y., 1908-1912.
- Raquette River at Piercefield, N. Y., 1908-
- Raquette River at South Colton, N. Y., 1904.
- Raquette River at Massena Springs, N. Y., 1903-1916.
  - Bog River near Tupper Lake, N. Y., 1908-1912.
- St. Regis River at Brasher Center, N. Y., 1910-
  - Deer River at Brasher Iron Works (railroad station), Ironton, N. Y., 1912-1916.
- Chateaugay River near Chateaugay, N. Y., 1908.
- Richelieu River at Fort Montgomery, N. Y., 1875-
  - Lake Champlain at Burlington, Vt., 1907-
    - Big Chazy River at Moors, N. Y., 1908.
    - Saranac River at Saranac Lake, N. Y., 1902-3.
    - Saranac River near Plattsburg, N. Y., 1903-
    - Ausable River, West Branch, near Newman, N. Y., 1916-

Streams tributary to the St. Lawrence—Continued.
- Richelieu River—Continued.
  - Lake Champlain—Continued.
    - Ausable River at Ausable Forks, N. Y., 1910–
    - Ausable River at Keeseville, N. Y., 1904 and 1908.
    - Boquet River at Willsboro, N. Y., 1904 and 1908.
    - Lake George at Rogers Rock, N. Y., 1913–
    - Lake George outlet at Ticonderoga, N. Y., 1904–5.
    - Poultney River at Fairhaven, Vt., 1908.
      - Mettawee River at Whitehall, N. Y., 1908.
    - Otter Creek at Middlebury, Vt., 1903–1907; 1910–
      - East Creek near Rutland, Vt., 1911–1913.
    - Winooski River above Stevens Branch, near Montpelier, Vt., 1909–1914.
    - Winooski River at Montpelier, Vt., 1909–
    - Winooski River at Richmond, Vt., 1903–1907; 1910.
    - Winooski River near Winooski, Vt., 1903.
      - Worcester Branch of Winooski River at Montpelier, Vt., 1909–1914.
      - Dog River at Northfield, Vt., 1909–
      - Dog River near Montpelier Junction, Vt., 1910.
      - Mad River at Moretown, Vt., 1910.
      - Little River near Waterbury, Vt., 1910.
      - Huntington River at Jonesville, Vt., 1910.
    - Lamoille River at Morrisville, Vt., 1909–10.
    - Lamoille River at Cadys Falls, near Morrisville, Vt., 1913–
    - Lamoille River at Johnson, Vt., 1910–1913.
    - Lamoille River at West Milton, Vt., 1903.
      - Green River at Garfield, Vt., 1915–
    - Missisquoi River at Richford, Vt., 1909–10.
    - Missisquoi River near Richford, Vt., 1911–
    - Missisquoi River at Swanton, Vt., 1903.
- St. Francis River (by way of Lake Memphremagog and Magog River):
  - Clyde River at West Derby, Vt., 1909–

REPORTS ON WATER RESOURCES OF THE ST. LAWRENCE RIVER BASIN.[1]

PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY.

WATER-SUPPLY PAPERS.

Water-supply papers are distributed free by the Geological Survey as long as its stock lasts. An asterisk (*) indicates that this stock has been exhausted. Many of the papers marked in this way may, however, be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C. Water-supply papers are of octavo size.

*21. Wells of Northern Indiana, by Frank Leverett. 1899. 82 pp., 2 pls. (Continued in No. 26.)

Discusses, by counties, the glacial deposits and the sources of well water; gives many well sections.

*24. Water resources of the State of New York, Part I, by G. W. Rafter. 1899. 99 pp., 13 pls. 15c.

*25. Water resources of the State of New York, Part II, by G. W. Rafter. 1899. 100 pp., 12 pls. 15c.

No. 24 contains descriptions of the principal rivers of New York and their more important tributaries and data on temperature, precipitation, evaporation, and stream flow.

No. 25 contains discussion of water-storage projects on Genesee and Hudson Rivers, power development at Niagara Falls, descriptions and early history of State canals, and a chapter on the use and value of the water powers of the streams and canals; also brief discussion of the water yield of sand areas of Long Island.

*26. Wells of southern Indiana (continuation of No. 21), by Frank Leverett. 1899. 64 pp. 5c.

Discusses, by counties, the glacial deposits and the sources of well water; contains many well sections.

30. Water resources of the Lower Peninsula of Michigan, by A. C. Lane. 1899. 97 pp. 7 pls.

Describes lake and river transportation and navigation, water powers and domestic water supplies; discusses climate, topography, geology, and well waters; compares quality and quantity of waters.

*31. Lower Michigan mineral waters, by A. C. Lane. 1899. 97 pp., 4 pls. 10c.

Treats of economic value of mineral waters and discussion and classification of analyses; contains analyses of waters of Lake Superior and of smaller lakes and rivers and of well waters from various geologic formations; also sanitary condition of drinking waters.

*57. Preliminary list of deep borings in the United States, Part I (Alabama-Montana), by N. H. Darton. 1902. 60 pp. (See No. 149.) 5c.

*61. Preliminary list of deep borings in the United States, Part II (Nebraska-Wyoming), by N. H. Darton. 1902. 67 pp. 5c.

Nos. 57 to 61 contain information as to depth, diameter, yield, and head of water in borings more than 400 feet deep; under head "Remarks" give information concerning temperature, quality of water, purposes of boring, etc. The lists are arranged by States, and the States are arranged alphabetically. A second, revised, edition was published in 1905 as Water-Supply Paper 149 (q. v.)

XIV.

91. The natural features and economic development of the Sandusky, Maumee, Muskingum, and Miami drainage areas in Ohio, by B. H. and M. S. Flynn. 1904. 130 pp. 10c.

Describes the topography, geology, and soils of the areas, and discusses stream flow, dams, water powers, and public water supplies.

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[1] For stream-measurement reports, see tables on pp. IV, V, VI.

102. Contributions to the hydrology of eastern United States, 1903; M. L. Fuller, geologist in charge. 1904. 522 pp. 30c.

Contains brief reports on wells and springs of Minnesota and of lower Michigan. The report comprises tabulated well records giving information as to location, owner, depth yield, head, etc., supplemented by notes as to elevation above sea, materials penetrated, temperature, use and quality; many miscellaneous analyses.

*108. A review of the laws forbidding pollution of inland waters in the United States, by E. B. Goodell. 1904. 120 pp. Superseded by 152.

Cites statutory restrictions of water pollution.

110. Contributions to the hydrology of eastern United States, 1904; M. L. Fuller, geologist in charge. 1905. 211 pp., 5 pls. 10c.

Contains:

Water resources of the Watkins Glen quadrangle, New York, by Ralph S. Tarr; pp. 134-140. Discusses the use of the surface and underground waters for municipal supplies and their quality as indicated by examination of Sixmile and Fall creeks, and sanitary analyses of well water at Ithaca.

New artesian water supply at Ithaca, New York, by F. L. Whitney, pp. 55-64.

*114. Underground waters of eastern United States; M. L. Fuller, geologist in charge. 1905. 285 pp., 18 pls. 25c.

Contains brief reports as follows:

Minnesota, by C. W. Hall; Wisconsin district, by Alfred R. Schultz; Lower Michigan; Illinois, by Frank Leverett; Indiana, by Frank Leverett; New York, by F. B. Weeks; Ohio, by Frank Leverett.

Each of these reports describes briefly the topography of the area, the relation of the geology to the water supplies, and gives list of pertinent publications; lists also principal mineral springs.

121. Preliminary report on the pollution of Lake Champlain, by M. O. Leighton. 1905. 119 pp., 13 pls. 20c.

Describes the lake and principal inflowing streams and discusses the characteristics of the water and the wastes resulting from the manufacturing processes by which the waters are polluted. Discusses also the effect of mill waste on algæ, bacteria, and fish.

*122. Relation of the law to underground waters, by D. W. Johnson. 1905. 55 pp. 5c.

Cites legislative acts relating to ground waters in Michigan and Wisconsin.

144. The normal distribution of chlorine in the natural waters of New York and New England, by D. D. Jackson. 1905. 31 pp., 5 pls. 10c.

Discusses common salt in coast and inland waters, salt as an index to pollution of streams and wells, the solutions and methods used in chlorine determinations, and the use of the normal chlorine map; gives charts and tables for chlorine in the New England States and New York.

145. Contributions to the hydrology of eastern United States, 1905; M. L. Fuller, geologist in charge. 1905. 220 pp., 6 pls. 10c.

Contains three brief reports pertaining chiefly to areas in the St. Lawrence River basin:

Two unusual types of artesian flow, by Myron L. Fuller. Describes (1) artesian flows from uniform, unconfined sand on Long Island, N. Y., and in Michigan; and (2) flow from jointed upper portion of limestone and other rocks in southeastern Michigan.

Water resources of the Catatonk area, New York, by E. M. Kindle. Describes topography and geology of areas southeast of Finger Lake region, New York, including part of city of Ithaca; discusses briefly the artesian wells of Ithaca, the quality of the spring water at several small towns, and of the streams used for municipal supplies and for power.

A ground-water problem in southeastern Michigan, by Myron L. Fuller. Discusses causes of failure of wells in certain areas in southeastern Michigan in 1904 and the application of the conclusions to other regions.

147. Destructive floods in the United States in 1904, by E. C. Murphy and others. 1905. 206 pp., 18 pls. 15c.

Describes flood on Grand River, Mich. (from report of R. E. Horton), discussing streams precipitation, and temperature, discharge, damage, and prevention of future damage.

*149. Preliminary list of deep borings in the United States, second edition, with additions, by N. H. Darton. 1905. 175 pp. 10c.

Gives by States (and within the States by counties) the location, depth, diameter, yield, height of water, and other features of wells 400 feet or more in depth; includes all wells listed in Water-Supply Papers 57 to 61; mentions also principal publications relating to deep borings.

*152. A review of the laws forbidding pollution of inland waters in the United States (second edition), by E. B. Goodell. 1905. 149 pp. 10c.

Cites statutory restrictions of water pollution in Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, Vermont, and Wisconsin.

*156. Water powers of northern Wisconsin, by L. S. Smith. 1906. 145 pp., 5 pls. 25c.

Describes, by river systems, the drainage, geology, topography, rainfall, and run-off, water powers and dams.

*160. Underground-water papers, 1906; M. L. Fuller, geologist in charge. 1906. 104 pp., 1 pl.

Contains brief report entitled Flowing well districts in the eastern part of the northern peninsula of Michigan, by Frank Leverett.

*162. Destructive floods in the United States in 1905, with a discussion of flood discharge and frequency and an index to flood literature, by E. C. Murphy and others. 1906. 105 pp., 4 pls. 15c.

Contains accounts of floods on Sixmile Creek and Cayuga Inlet, N. Y. (in 1857, 1901, and 1905), and on Grand River, Mich., and estimate of flood discharge and frequency for Genesee River; gives index to literature on floods in American streams.

*182. Flowing wells and municipal water supplies in the southern portion of the southern peninsula of Michigan, by Frank Leverett and others. 1906. 292 pp., 5 pls. 50c.

*183. Flowing wells and municipal water supplies in the middle and northern portions of the southern peninsula of Michigan, by Frank Leverett and others. 1907. 393 pp., 5 pls. 50c.

Nos. 182 and 183 describe in general the geographic features, water-bearing formations, drainage, quality of water, and subterranean-water temperature, and give details concerning water supplies by counties. The report contains many analyses.

*193. The quality of surface waters in Minnesota, by R. B. Dole and F. F. Wesbrook, 1907. 171 pp., 7 pls. 25c.

Describes by river basins the topography, geology, and soils, the industrial and municipal pollution of the streams, and gives notes on the municipalities; contains many analyses.

*194. Pollution of Illinois and Mississippi rivers by Chicago sewage (a digest of the testimony taken in the case of the State of Missouri *v.* the State of Illinois and the Sanitary District of Chicago), by M. O. Leighton. 1907. 369 pp., 2 pls.

Scope indicated by amplification of title.

236. The quality of surface water in the United States: Part I, Analyses of waters east of the one hundredth meridian, by R. B. Dole. 1909. 123 pp. 10c.

Describes collection of samples, method of examination, preparation of solutions, accuracy of estimates, and expression of analytical results; gives results of analyses of waters of Lake Superior and Lake Michigan, Kalamazoo and Grand rivers, Lake Huron, Lake Erie, Maumee River and St. Lawrence and Oswegatchie rivers.

239. The quality of the surface waters of Illinois, by W. D. Collins. 1910. 94 pp., 3 pls. 10c.

Discusses the natural and economic features that determine the character of the streams describes the larger drainage basins and the methods of collecting and analyzing the samples of water, and discusses each river in detail with reference to its source, course, and quality of water; includes short chapters on municipal supplies and industrial uses.

254. The underground waters of north-central Indiana, by S. R. Capps, with a chapter on the chemical character of the waters, by R. B. Dole. 1910. 279 pp., 7 pls. 40c.

Describes relief, drainage, vegetation, soils and crops, industrial development, geologic formations; sources, movements, occurrence, and volume of ground water; methods of well construction and lifting devices; discusses in detail, for each county, surface features and drainage, geology, and ground water, city, village, and rural supplies, and gives record of wells and analyses of water. Discusses also, under chemical character, methods of analyses and expression of results, mineral constituents, effects of the constituents on waters for domestic, industrial, and medicinal uses, methods of purification and chemical composition; many analyses and field assays.

364. Water analyses fron the laboratory of the United States Geological Survey, tabulated by F. W. Clarke, chief chemist. 1914. 40 pp. 5c.

Contains analyses of water from Caledonia Spring, New York, and from the Quincy mine, Mich.

417. Profile surveys of rivers in Wisconsin, prepared under the direction of W. H. Herron, acting chief geographer. 1917. 16 pp., 32 pls. 45c.

Contains brief description of general features of drainage of Wisconsin and of the rivers surveyed, but consists chiefly of maps showing "not only the outlines of the river banks, the islands, the positions of rapids, falls, shoals, and existing dams, and the crossings of all ferries and roads, but the contours of banks to an elevation high enough to indicate the possibility of using the stream."

ANNUAL REPORTS.

Each of the papers contained in the annual reports was also issued in separate form.

Annual reports are distributed free by the Geological Survey as long as its stock lasts. An asterisk (*) indicates that this stock has been exhausted. Many of the papers so marked, however, may be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C.

Annual reports 1 to 26 are royal octavo; later reports are octavo.

Fourteenth Annual Report of the United States Geological Survey, 1892–93, J. W. Powell, Director. 1893. (Pt. II, 1894.) 2 parts. *Pt. II. Accompanying papers, xx, 597 pp., 73 pls. $2.10. Contains:

*The potable waters of eastern United States, by W. J. McGee, pp. 1 to 47. Discusses cistern water, stream waters, and ground waters, including mineral springs and artesian wells.

Seventeenth Annual Report of the United States Geological Survey, 1895–96, Charles D. Walcott, Director. 1896. 3 parts in 4 vols. * Pt. II. Economic geology and hydrography, xxv, 864 pp., 113 pls. $2.35. Contains:

*The water resources of Illinois, by Frank Leverett, pp. 695–849, pls. 106–113. Describes the physical features of the State, and the drainage basins, including Illinois, Des Plaines, Kankakee, Fox, Illinois-Vermilion, Spoon, Mackinaw, and Sangamon rivers, Macoupin Creek, Rock River, tributaries of the Mississippi in western Illinois, Kaskaskia, Big Muddy, and tributaries of the Wabash; discusses the rainfall and run-off, navigable waters and water powers, the wells supplying water for rural districts, and artesian wells :contains tabulated artesian well data and water analyses.

Eighteenth Annual Report, United States Geological Survey, 1896–97, Charles D. Walcott, Director. 1897. 5 parts in 6 volumes. *Pt. IV, Hydrography, x, 756 pp., 102 pls. $1.75. Contains:

*The water resources of Indiana and Ohio, by Frank Leverett, pp. 419–560, pls. 33–37. Describes Wabash, Whitewater, Great Miami, Little Miami, Scioto, Hocking, Muskingum, and Beaver rivers and lesser tributaries of the Ohio in Indiana and Ohio, the streams discharging into Lake Erie and Lake Michigan, and streams flowing to the Upper Mississippi through the Illinois; discusses shallow and drift wells, the flowing wells from the drift and deeper artesian wells, and gives records of wells at many of the cities; describes the mineral springs and gives analyses of the waters; contains also tabulated lists of cities using surface waters for water works, and of cities and villages using shallow and deep well waters; discusses the source and quality of the city and village supplies, and gives precipitation tables for various points.

Nineteenth Annual Report of the United States Geological Survey, 1897–98, Charles D. Walcott, Director. 1898. (Pts. II, III, and V, 1899.) 6 parts in 7 volumes and separate case for maps with Pt. V. *Pt. IV. Hydrography. $1.85. Contains:

*The rock waters of Ohio, by Edward Orton, pp. 633-717, pls. 71-73. Describes the principal geologic formations of Ohio and the waters from the different strata; discusses the flowing wells at various points and the artesian wells of the deep preglacial channels in Allen, Auglaize and Mercer counties; discusses city and village supplies; gives analyses of waters from various formations.

MONOGRAPHS.

Monographs are of quarto size. They are not distributed free, but may be obtained from the Geological Survey or from the Superintendent of Documents at the prices given. An asterisk (*) indicates that the Survey's stock of the paper is exhausted. (See Finding lists, pp. 89, 118.)

XLI. Glacial formations and drainage features of the Erie and Ohio basins, by Frank Leverett. 1902. 802 pp., 26 pls. $1.75.

Treats of an area extending westward from Genesee Valley in New York across northwestern Pennsylvania and Ohio, central and southern Indiana, and southward from Lakes Ontario and Erie to Allegheny and Ohio rivers.

BULLETINS.

An asterisk (*) indicates that the Geological Survey's stock of paper is exhausted. Many of the papers so marked may be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C.

*264. Record of deep-well drilling for 1904, by M. L. Fuller, E. F. Lines, and A. C. Veatch. 1905. 106 pp. 10c.

Discusses the importance of accurate well records to the driller, to owners of oil, gas, and water wells, and to the geologist; describes the general methods of work; gives tabulated records of wells in Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin, and detailed records of wells in Onondaga County, N. Y., and Hancock and Wood counties, Ohio. These wells were selected because they give definite stratigraphic information.

*298. Record of deep-well drilling for 1905, by M. L. Fuller and Samuel Sanford. 1906. 299 pp. 25c.

Gives an account of progress in the collection of well records and samples; contains tabulated records of wells in Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, Vermont, and Wisconsin, and detailed records of wells in Cook County, Ill.; Erie County, N. Y.; Ottawa, Sandusky, and Summit counties, Ohio; and Manitowoc County, Wis. The wells of which detailed sections are given were selected because they afford valuable stratigraphic information.

GEOLOGIC FOLIOS.

Under the plan adopted for the preparation of a geologic map of the United States the entire area is divided into small quadrangles, bounded by certain meridians and parallels, and these quadrangles, which number several thousand, are separately surveyed and mapped.[1] The unit of survey is also the unit of publication, and the maps and description of each quadrangle are issued in the form of a folio. When all the folios are completed they will constitute the Geologic Atlas of the United States.

A folio is designated by the name of the principal town or of a prominent natural feature within the quadrangle. Each folio includes maps showing the topography, geology, underground structure, and mineral deposits of the area mapped and several pages of descriptive text. The text explains the maps and describes the topographic and geologic features of the country and its mineral products. The topographic map shows roads, railroads, waterways, and, by contour lines, the shapes of the hills and valleys and the height above sea level of all points in the quadrangle. The areal-geology map shows the distribution of the various rocks at the surface. The structural-geology map shows the relations of the rocks to one another underground. The economic-geology map indicates the location of mineral deposits that are commercially valuable. The artesian-water map shows the depth of underground-water horizens. Economic-geology and artesian-water maps are included in folios if the conditions in the areas mapped warrant their publication. The folios are of special interest to students of geography and geology and are valuable as guides in the development and utilization of mineral resources.

Folios 1 to 163, inclusive, are published in only one form (18 by 22 inches), called the library edition. Some of the folios that bear numbers higher than 163 are published also in an octavo edition (6 by 9 inches). Owing to a fire in the Geological Survey building May 18, 1913, the stock of geologic folios was more or less damaged by fire and water, but 80 or 90 per cent of the folios are usable. They will be sold at the uniform price of 5 cents each, with no reduction for wholesale orders. This rate applies to folios in stock from 1 to 184, inclusive (except reprints), also to the library edition of folio 186. The library edition of Folios 185, 187, and higher numbers sells for 25 cents a copy, except that some folios which contain an unusually large amount of matter sell at higher prices. The octavo edition of Folio 185 and higher numbers sell for 50 cents a copy, except Folio 193, which sells for 75 cents a copy. A discount of 40 per cent is allowed on an order for folios or for folios together with topographic maps amounting to $5 or more at the retail rate.

[1] Index maps showing areas in the St. Lawrence basin covered by topographic maps and by geologic folios will be mailed on receipt of request addressed to the director U. S. Geological Survey, Washington, D. C.

All the folios contain descriptions of the drainage of the quadrangles. The folios in the following list contain also brief discussions of the underground waters in connection with the economic resources of the areas and more or less information concerning the utilization of the water resources.

An asterisk (*) indicates that the stock of the folio is exhausted.

*81. Chicago, Illinois-Indiana.

Describes an area embracing not only the immediate site of the city but adjacent parts of Cook, Dupage, and Will counties, Ill.; gives an account of the water power, discusses the quality of the waters, and gives analyses of waters from artesian wells; gives also a list of papers relating to the geology and paleontology of the area.

*140. Milwaukee special, Wisconsin, 5c.

Gives analyses of spring waters and of artesian water in Milwaukee; also tabulated data concerning wells.

155. Ann Arbor, Mich. 25c.

Discusses the present lakes, the lakes of the glacial period, and under "Economic geology," the water resources, including the use of the rivers for power and of the underground waters, shallow and artesian, for city and village supplies; discusses the quality of the waters, and gives details by townships.

*169. Watkins Glen-Catatonk, New York.

Includes discussion of water supply at Ithaca.

190. Niagara, N. Y. 50c. either edition.

Gives analyses of mineral water from well at Akron; discusses briefly the municipal supplies of Buffalo, Niagara Falls, Tonawanda, La Salle, and Youngstown, and the use of Niagara River for power development.

205. Detroit, Mich. 50c. either edition.

Discusses surface and ground waters; gives mineral analyses of water from Lake Huron, from rivers near Detroit, and from salt wells.

MISCELLANEOUS REPORTS.

Other Federal bureaus and State and other organizations have from time to time published reports relating to the water resources of the various sections of the country. Notable among those pertaining to the St. Lawrence River basin are the reports of the Chief of Engineers, United States Army, the State Geological Survey of Illinois, the Illinois Water-Supply Commission, the Rivers and Lakes Commission of Illinois, the New York State Conservation Commission and State Water-Supply Commission, and the water-power report of the Tenth Census (vol. 16). The following reports deserve special mention:

The mineral content of Illinois waters, by Edward Bartow, J. A. Udden, S. W. Parr, and George T. Palmer: Illinois State Geol. Survey Bull. 10, 1909.

Chemical and biological survey of waters of Illinois, by Edward Bartow: Univ. Illinois Pubs. 3, 6, 7, 1906–1909.

Chemical survey of the waters of Illinois, report for the years 1897–1902, by A. W. Palmer, with report on geology of Illinois as related to its water supply, by Charles W. Rolfe: Univ. Illinois Pub.

Diversion of the waters of the Great Lakes by way of the Sanitary and Ship canal of Chicago: A brief of the facts and issues, by Lyman E. Cooley, Chicago, 1913.

The State of Missouri *v.* the State of Illinois and the Sanitary district of Chicago, before Frank S. Bright, commissioner of the Supreme Court of the United States, 1904.

The mineral waters of Indiana, their location, origin, and character, by W. S. Blatchley: Indiana Dept. Geology and Nat. Res. Twenty-sixth Ann. Rept., 1901.

*64. Accuracy of stream measurements, by E. C. Murphy. 1902. 99 pp., 4 pls. (See No. 95.) 10c.

Describes methods of measuring velocity of water and of measuring and computing stream flow and compares results obtained with the different instruments and methods; describes also experiments and results at the Cornell University hydraulic laboratory. A second, enlarged, edition published as Water-Supply Paper 95.

*67. The motions of underground waters, by C. S. Slichter. 1902. 106 pp., 8 pls. 15c.

Discusses origin, depth, and amount of underground waters; permeability of rocks and porosity of soils; causes, rates, and laws of motion of underground water; surface and deep zones of flow and recovery of waters by open wells and artesian and deep wells; treats of the shape and position of the water table; gives simple methods of measuring yield of flowing well; describes artesian wells at Savannah, Ga.

72. Sewage pollution in the metropolitan area near New York City and its effect on inland-water resources, by M. O. Leighton. 1902. 75 pp., 8 pls. 10c.

Defines "normal" and "polluted" waters and discusses the damage resulting from pollution.

79. Normal and polluted waters in northeastern United States, by M. O. Leighton. 1903. 192 pp. 10c.

Defines essential qualities of water for various uses, the impurities in rain, surface, and underground waters, the meaning and importance of sanitary analyses, and the principal sources of pollution; chiefly, "a review of the more readily available records" of examination of water supplies derived from streams in the Merrimack, Connecticut, Housatonic, Delaware, and Ohio River basins; contains many analyses.

*80. The relation of rainfall to run-off, by G. W. Rafter. 1903. 104 pp. 10c.

Treats of measurements of rainfall and laws and measurements of stream flow; gives rainfall, run-off, and evaporation formulas; discusses effect of forests on rainfall and run-off.

87. Irrigation in India (second edition), by H. M. Wilson. 1903. 238 pp., 27 pls. 25c.

First edition was published in Part II of the Twelfth Annual Report.

93. Proceedings of first conference of engineers of the Reclamation Service, with accompanying papers, compiled by F. H. Newell, chief engineer. 1904. 361 pp. 25c.

Contains, in addition to an account of the organization of the hydrographic [water-resources] branch of the United States Geological Survey and the reports of the conference, the following papers of more or less general interest:

Limits of an irrigation project, by D. W. Ross.
Relation of Federal and State laws to irrigation, by Morris Bien.
Electrical transmission of power for pumping, by H. A. Storrs.
Correct design and stability of high masonry dams, by Geo. Y. Wisner.
Irrigation surveys and the use of the plane table, by J. B. Lippincott.
The use of alkaline waters for irrigation, by Thomas A. Means.

*94. Hydrographic manual of the United States Geological Survey, prepared by E. C. Murphy, J. C. Hoyt, and G. B. Hollister. 1904. 76 pp., 3 pls. 10c.

Gives instructions for field and office work relating to measurements of stream flow by current meters. See also No. 95.

*95. Accuracy of stream measurements (second, enlarged edition), by E. C. Murphy. 1904. 169 pp., 6 pls.

Describes methods of measuring and computing stream flow and compares results derived from different instruments and methods. See also No. 94.

*103. A review of the laws forbidding pollution of inland waters in the United States, by E. B. Goodell. 1904. 120 pp. (See No. 152.)

Explains the legal principles under which antipollution statutes become operative, quotes court decisions to show authority for various deductions, and classifies according to scope the statutes enacted in the different States.

110. Contributions to the hydrology of eastern United States, 1904; M. L. Fuller, geologist in charge. 1905. 211 pp., 5 pls. 10c.

Contains the following reports of general interest. The scope of each paper is indicated by its title.

Description of underflow meter used in measuring the velocity and direction of underground water, by Charles S. Slichter.

The California or "stovepipe" method of well construction, by Charles S. Slichter.

Approximate methods of measuring the yield of flowing wells, by Charles S. Slichter.

Corrections necessary in accurate determinations of flow from vertical well casings, from notes furnished by A. N. Talbot.

Experiment relating to problems of well contamination at Quitman, Ga., by S. W. McCallie.

Notes on the hydrology of Cuba, by M. L. Fuller.

113. The disposal of strawboard and oil-well wastes, by R. L. Sackett and Isaiah Bowman. 1905. 52 pp., 4 pls. 5c.

The first paper discusses the pollution of streams by sewage and by trade wastes, describes the manufacture of strawboard, and gives results of various experiments in disposing of the waste. The second paper describes briefly the topography, drainage, and geology of the region about Marion, Ind., the contamination of rock wells and of streams by waste oil and brine.

*114. Undergound waters of eastern United States; M. L. Fuller, geologist in charge. 1905. 285 pp., 18 pls. 25c.

Contains report on "Occurrence of underground waters," by M. L. Fuller, discussing sources, amount, and temperature of waters, permeability and storage capacity of rocks, water-bearing formations, recovery of water by springs, wells, and pumps, essential conditions of artesian flows, and general conditions affecting underground waters in eastern United States.

119. Index to the hydrographic progress reports of the United States Geological Survey, 1888 to 1903, by J. C. Hoyt and B. D. Wood. 1905. 253 pp. 15c.

Scope indicated by title.

120. Bibliographic review and index of papers relating to underground waters published by the United States Geological Survey, 1879–1904, by M. L. Fuller, 1905. 128 pp. 10c.

Scope indicated by title.

*122. Relation of the law to underground waters, by D. W. Johnson. 1905. 55 pp. 5c.

Defines and classifies underground waters, gives common-law rules relating to their use, and cites State legislative acts affecting them.

140. Field measurements of the rate of movement of underground waters, by C. S. Slichter. 1905. 122 pp., 15 pls. 15c.

Discusses the capacity of sand to transmit water, describes measurements of underflow in Rio Hondo, San Gabriel, and Mohave River valleys, Cal., and on Long Island, N. Y., gives results of tests of wells and pumping plants, and describes stovepipe method of well construction.

143. Experiments on steel-concrete pipes on a working scale, by J. H. Quinton. 1905. 61 pp., 4 pls. 5c.

Scope indicated by title.

145. Contributions to the hydrology of eastern United States, 1905; M. L. Fuller, geologist in charge. 1905. 220 pp., 6 pls. 10c.

Contains brief reports of general interest as follows:

Drainage of ponds into drilled wells, by Robert E. Horton. Discusses efficiency, cost, and capacity of drainage wells, and gives statistics of such wells in southern Michigan.

Construction of so-called fountain and geyser springs, by Myron L. Fuller.

A convenient gage for determining low artesian heads, by Myron L. Fuller.

146. Proceedings of second conference of engineers of the Reclamation Service, with accompanying papers, compiled by F. H. Newell, chief engineer. 1905. 267 pp. 15c.

Contains brief account of the organization of the hydrographic [water-resources] branch and the Reclamation Service, reports of conferences and committees, circulars of instruction, and many brief reports on subjects closely related to reclamation, and a bibliography of technical papers by members of the service. Of the papers read at the conference those listed below (scope indicated by title) are of more or less general interest:

Proposed State code of water laws, by Morris Bien.
Power engineering applied to irrigation problems, by O. H. Ensign.
Estimates on tunneling in irrigation projects, by A. L. Fellows.
Collection of stream-gaging data, by N. C. Grover.
Diamond-drill methods, by G. A. Hammond.
Mean-velocity and area curves, by F. W. Hanna.
Importance of general hydrographic data concerning basins of streams gaged, by R. E. Horton.
Effect of aquatic vegetation on stream flow, by R. E. Horton.
Sanitary regulations governing construction camps, by M. O. Leighton.
Necessity of draining irrigated land, by Thos. H. Means.
Alkali soils, by Thos. H. Means.
Cost of stream-gaging work, by E. C. Murphy.
Equipment of a cable gaging station, by E. C. Murphy.
Silting of reservoirs, by W. M. Reed.
Farm-unit classification, by D. W. Ross.
Cost of power for pumping irrigating water, by H. A. Storrs.
Records of flow at current-meter gaging stations during the frozen season, by F. H. Tillinghast.

147. Destructive floods in the United States in 1904, by E. C. Murphy and others. 1905. 206 pp., 18 pls. 15c.

Contains a brief account of "A method of computing cross-section area of waterways," including formulas for maximum discharge and areas of cross section.

*149. Preliminary list of deep borings in the United States, second edition, with additions, by N. H. Darton. 1905. 175 pp. 10c.

Gives by States (and within the States by counties), location, depth, diameter, yield, height of water, and other available information, concerning wells 400 feet or more in depth; includes all wells listed in Water-Supply Papers 57 to 61; mentions also principal publications relating to deep borings.

*150. Weir experiments, coefficients, and formulas, by R. E. Horton. 1906. 189 pp., 38 pls. (See Water-Supply Paper 200.) 15c.

Scope indicated by title.

151. Field assay of water, by M. O. Leighton. 1905. 77 pp., 4 pls.

Discusses methods, instruments, and reagents used in determining turbidity, color, iron, chlorides, and hardness in connection with the studies of the quality of water in various parts of the United States.

*152. A review of the laws forbidding pollution of inland waters in the United States (second edition), by E. B. Goodell. 1905. 149 pp. 10c.

Scope indicated by title.

*160. Underground-water papers, 1906; M. L. Fuller, geologist in charge. 1906. 104 pp., 1 pl.

Gives account of work in 1905; lists of publications relating to underground waters, and contains the following brief reports of general interest:

Significance of the term "artesian," by Myron L. Fuller.
Representation of wells and springs on maps, by Myron L. Fuller.
Total amount of free water in the earth's crust, by Myron L. Fuller.
Use of fluorescein in the study of underground waters, by R. B. Dole.
Problems of water contamination, by Isaiah Bowman.
Instances of improvement of water in wells, by Myron L. Fuller.

*162. Destructive floods in the United States in 1905, with a discussion of flood discharge and frequency and an index to flood literature, by E. C. Murphy and others. 1906. 105 pp., 4 pls. 15c.

*163. Bibliographic review and index of underground-water literature published in the United States in 1905, by M. L. Fuller, F. G. Clapp, and B. L. Johnson. 1906. 130 pp. 15c.

Scope indicated by title.

*179. Prevention of stream pollution by distillery refuse, based on investigations at Lynchburg, Ohio, by Herman Stabler. 1906. 34 pp., 1 pl. 10c.

Describes grain distillation, treatment of slop, sources, character, and effects of effluents on streams; discusses filtration, precipitation, fermentation, and evaporation methods of disposal of wastes without pollution.

*180. Turbine water wheel tests and power tables, by R. E. Horton. 1906. 134 pp. 2 pls. 20c.

Scope indicated by title.

*185. Investigations on the purification of Boston sewage, by C. E. A. Winslow and E. B. Phelps. 1906. 163 pp. 25c.

Discusses composition, disposal, purification, and treatment of sewages and recent tendencies in sewage-disposal practice in England, Germany, and the United States; describes character of crude sewage at Boston, removal of suspended matter, treatment in septic tanks, and purification in intermittent sand filtration and coarse material; gives bibliography.

*186. Stream pollution by acid-iron wastes, a report based on investigations made at Shelby, Ohio, by Herman Stabler. 1906. 36 pp., 1 pl.

Gives history of pollution by acid-iron wastes at Shelby, Ohio, and resulting litigation; discusses effect of acid-iron liquors on sewage purification processes, recovery of copperas from acid iron wastes, and other processes for removal of pickling liquor.

*187. Determination of stream flow during the frozen season, by H. K. Barrows and R. E. Horton. 1907. 93 pp., 1 pl. 15c.

Scope indicated by title.

*189. The prevention of stream pollution by strawboard waste, by E. B. Phelps. 1906. 29 pp., 2 pls.

Describes manufacture of strawboard, present and proposed methods of disposal of waste liquors, laboratory investigations of precipitation and sedimentation, and field studies of amount and character of water used, raw material and finished product, and mechanical filtration.

*194. Pollution of Illinois and Mississippi rivers by Chicago sewage (a digest of the testimony taken in the case of The State of Missouri *v.* The State of Illinois and the Sanitary District of Chicago), by M. O. Leighton. 1907. 369 pp., 2 pls.

Scope indicated by amplification of title.

*200. Weir experiments, coefficients, and formulas (revision of paper No. 150), by R. E. Horton. 1907. 195 pp., 38 pls. 35c.

Scope indicated by title.

*226. The pollution of streams by sulphite-pulp waste, a study of possible remedies, by E. B. Phelps. 1909. 37 pp., 1 pl. 10c.

Describes the manufacture of sulphite pulp, the waste liquors, and the experimental work leading to suggestions as to methods of preventing stream pollution.

*229. The disinfection of sewage and sewage filter effluents, with a chapter on the putrescibility and stability of sewage effluents, by E. B. Phelps. 1909. 91 pp., 1 pl. 15c.

Scope indicated by title.

*234. Papers on the conservation of water resources. 1909. 96 pp., 2 pls. 15c.

Contains the following papers, whose scope is indicated by their titles: Distribution of rainfall, by Henry Gannett; Floods, by M. O. Leighton; Developed water powers, compiled under the direction of W. M. Steuart, with discussion by M. O. Leighton; Undeveloped water powers, by M. O. Leighton; Irrigation, by F. H. Newell; Underground waters, by W. C. Mendenhall; Denudation, by R. B. Dole and Herman Stabler; Control of catchment areas, by H. N. Parker.

*235. The purification of some textile and other factory wastes, by Herman Stabler and G. H. Pratt. 1909. 76 pp. 10c.

Discusses waste waters from wool scouring, bleaching and dyeing cotton yarn, bleaching cotton piece goods, and manufacture of oleomargarine, fertilizer, and glue.

236. The quality of surface waters in the United States: Part I, Analyses of waters east of the one hundredth meridian, by R. B. Dole. 1909. 123 pp. 10c.

Describes collection of samples, method of examination, preparation of solutions, accuracy of estimates, and expression of analytical results.

238. The public utility of water powers and their governmental regulation, by René Tavernier and M. O. Leighton. 1910. 161 pp. 15c.

Discusses hydraulic power and irrigation, French, Italian, and Swiss legislation relative to the development of water powers, and laws proposed in the French Parliament; reviews work of bureau of hydraulics and agricultural improvement and the French department of agriculture, and gives résumé of Federal and State water-power legislation in the United States.

*255. Underground waters for farm use, by M. L. Fuller. 1910. 58 pp., 17 pls. 15c.

Discusses rocks as sources of water supply and the relative safety of supplies from different materials; springs and their protection; open or dug and deep wells, their location, yield, relative cost, protection, and safety; advantages and disadvantages of cisterns and combination wells and cisterns.

*257. Well-drilling methods, by Isaiah Bowman. 1911. 139 pp., 4 pls. 15c.

Discusses amount, distribution, and disposal of rainfall, water-bearing rocks, amount of underground water, artesian conditions, and oil and gas bearing formations; gives history of well drilling in Asia, Europe, and the United States; describes in detail the various methods and the machinery used; discusses loss of tools and geologic difficulties; contamination of well waters and methods of prevention; tests of capacity and measurement of depth; and of costs sinking wells.

*258. Underground-water papers, 1910, by M. L. Fuller, F. G. Clapp, G. C. Matson, Samuel Sanford, and H. C. Wolff. 1911. 123 pp., 2 pls. 15c.

Contains the following papers (scope indicated by titles) of general interest:
Drainage of wells, by M. L. Fuller.
Freezing of wells and related phenomena, by M. L. Fuller.
Pollution of underground waters in limestone, by G. C. Matson.
Protection of shallow wells in sandy deposits, by M. L. Fuller.
Magnetic wells, by M. L. Fuller.

259. The underground waters of southwestern Ohio, by M. L. Fuller and F. G. Clapp, with a discussion of the chemical character of the waters, by R. B. Dole. 1912. 228 pp., 9 pls. 35c.

Describes the topography, climate, and geology of the region, the water-bearing formations, the source, mode of occurrence, and head of the waters, and municipal supplies; gives details by counties; discusses in supplement, under chemical character, method of analysis and expression of results, mineral constituents, effect of the constituents on waters for domestic, industrial, and medicinal uses, methods of purification, chemical composition; many analyses and field assays. The matter in the supplement was also published in Water-Supply Paper 254 (The underground waters of north-central Indiana).

274. Some stream waters of the western United States, with chapters on sediment carried by the Rio Grande and the industrial application of water analyses, by Herman Stabler. 1911. 188 pp. 15c.

Describes collection of samples, plan of analytical work, and methods of analyses; discusses soap-consuming power of waters, water softening, boiler waters, and water for irrigation; gives results of analyses of waters of the Rio Grande and of Pecos, Gallinas, and Hondo rivers.

*315. The purification of public water supplies, by G. A. Johnson. 1913. 84 pp., 8 pls. 10c.

Discusses ground, lake, and river waters as public supplies, development of waterworks systems in the United States, water consumption, and typhoid fever; describes methods of filtration and sterilization of water and municipal water softening.

334. The Ohio Valley flood of March–April, 1913 (including comparisons with some earlier floods), by A. H. Horton and H. J. Jackson. 1913. 96 pp., 22 pls. 20c.

Although relating specifically to floods in the Ohio Valley, this report discusses also the causes of floods and the prevention of damage by floods.

337. The effects of ice on stream flow, by William Glenn Hoyt. 1913. 77 pp., 7 pls. 15c.

Discusses methods of measuring the winter flow of streams.

*345. Contributions to the hydrology of the United States, 1914. N. C. Grover, chief hydraulic engineer. 1915. 225 pp., 17 pls. 30c.

*(*e*) A method of determining the daily discharge of rivers of variable slope, by M. R. Hall, W. E. Hall, and C. H. Pierce, pp. 53–65.
Scope indicated by title.

364. Water analyses from the laboratory of the United States Geological Survey, tabulated by F. W. Clarke, chief chemist. 1914. 40 pp. 5c.

Contains analyses of waters from rivers, lakes, wells, and springs in various parts of the United States, including analyses of the geyser water of Yellowstone National Park, hot springs in Montana, brines from Death Valley, water from the Gulf of Mexico, and mine waters from Tennessee, Michigan, Missouri and Oklahoma, Montana, Colorado and Utah, Nevada and Arizona, and California.

371. Equipment for current-meter gaging stations, by G. J. Lyon. 1915. 64 pp., 37 pls. 20c.

Describes methods of installing automatic and other gages and of constructing gage wells, shelters, and structures for making discharge measurements and artificial controls.

*375. Contributions to the hydrology of the United States, 1915. N. C. Grover, chief hydraulic engineer. 1916. 181 pp., 9 pls. 15c.

(*c*) The relation of stream gaging to the science of hydraulics, by C. H. Pierce and R. W. Davenport, pp. 77–84.
(*e*) A method of correcting river discharge for a changing stage, by B. E Jones, pp. 117–130.
(*f*) Conditions requiring the use of automatic gages in obtaining records of stream flow, by C. H. Pierce, pp. 131–139.
Three papers presented at the conference of engineers of the water-resources branch in December, 1914.

*400. Contributions to the hydrology of the United States, 1916. N. C. Grover, chief hydraulic engineer.

(*a*) The people's interest in water-power resources, by G. O. Smith, pp. 1–8.
(*c*) The measurement of silt-laden streams, by Raymond C. Pierce, pp. 39–51.
(*d*) Accuracy of stream-flow data, by N. C. Grover and J. C. Hoyt, pp. 53–59.

416. The divining rod, a history of water witching, with a bibliography, by Arthur J Ellis. 1917. 59 pp. 10c.

A brief paper published "merely to furnish a reply to the numerous inquiries that are continually being received from all parts of the country" as to the efficacy of the divining rod for locating underground water.

425. Contributions to the hydrology of the United States, 1917; N. C. Grover, chief hydraulic engineer. 1918. Contains:

(*c*) Hydraulic conversion tables and convenient equivalents, pp. 71–94. 1917.

427. Bibliography and index of the publications of the United States Geological Survey relating to ground water, by O. E. Meinzer. 1918. 169 pp., 1 pl.

Includes publications prepared, in whole or part, by the Geological Survey that treat any phase of the subject of ground water or any subject directly applicable to ground water. Illustrated by map showing reports that cover specific areas more or less thoroughly.

ANNUAL REPORTS.

*Fifth Annual Report of the United States Geological Survey, 1883–84, J. W. Powell, Director. 1885. xxxvi, 469 pp., 58 pls. $2.25. Contains:

*The requisite and qualifying conditions of artesian wells, by T. C. Chamberlin, pp. 125–173, Pl. 21. Scope indicated by title.

Twelfth Annual Report of the United States Geological Survey, 1890–91, J. W. Powell, Director. 1891. 2 parts. Pt. II, Irrigation, xviii, 576 pp., 93 pls. $2. Contains:

*Irrigation in India, by H. M. Wilson, pp. 375–561, pls. 107–146. See Water-Supply Paper 87.

Thirteenth Annual Report of the United States Geological Survey, 1891–92, J. W. Powell, Director. 1892. (Pts. II and III, 1893.) 3 parts. *Pt. III, Irrigation, xi, 486 pp., 77 pls. $1.85. Contains:

*American irrigation engineering, by H. M. Wilson, pp. 101–349, pls. 111–145. Discusses the economic aspects of irrigation, alkaline drainage, silt, and sedimentation; gives brief history of legislation; describes perennial canals in Idaho-Calofornia, Wyoming, and Arizona; discusses water storage at reservoirs of the California and other projects, subsurface sources of supply, pumping, and subirrigation.

Fourteenth Annual Report of the United States Geological Survey, 1892–93, J. W. Powell, Director. 1893. (Pt. II, 1894.) 2 parts. *Pt. II, Accompanying papers, xx, 597 pp., 73 pls. $2.10. Contains:

*The potable waters of eastern United States, by W. J. McGee, pp. 1–47. Discusses cistern water, stream waters, and ground waters, including mineral springs and artesian wells.

*Natural mineral waters of the United States, by A. C. Peale, pp. 49–88, pls. 3 and 4. Discusses the origin and flow of mineral springs, the source of mineralization, thermal springs, the chemical composition and analysis of spring waters, geographic distribution, and the utilization of mineral waters; gives a list of American mineral spring resorts; contains also some analyses.

Nineteenth Annual Report of the United States Geological Survey, 1897–98, Charles D. Walcott, Director. 1898. (Parts II, III, and V, 1899.) 6 parts in 7 vols. and separate case for maps with Pt. V. *Pt. II, papers chiefly of a theoretic nature, v, 958 pp., 127 pls. $2.65. Contains:

*Principles and conditions of the movements of ground water, by F. H. King, pp. 59–294, pls. 6–16. Discusses the amount of water stored in sandstone, in soil, and in other rocks, the depth to which ground water penetrates; gravitational, thermal, and capillary movements of ground waters, and the configuration of the ground-water surface; gives the results of experimental investigations on the flow of air and water through a rigid, porous media, and through sand, sandstones, and silts; discusses results obtained by other investigators, and summarizes results of observations; discusses also rate of flow of water through sand and rock, the growth of rivers, rate of filtration through soil, interference of wells, etc.

*Theoretical investigation of the motion of ground waters, by C. S. Slichter, pp. 295–384, pls. 17. Scope indicated by title.

PROFESSIONAL PAPERS.

*72. Denudation and erosion in the southern Appalachian region and the Monongahela basin, by L. C. Glenn. 1911. 137 pp., 21 pls. 35c.

Describes the topography, geology, drainage, forests, climate and population, and transportation facilities of the region, the relation of agriculture, lumbering, mining, and power development to erosion and denudation, and the nature, effects, and remedies of erosion; gives details of conditions in Holston, Nolichucky, French Broad, Little Tennessee, and Hiwassee river basins, along Tennessee River proper, and in the basins of the Coosa-Alabama system, Chattahoochee, Savannah, Saluda, Broad, Catawba, Yadkin, New, and Monongahela rivers.

86 The transportation of débris by running water, by G. K. Gilbert, based on experiments made with the assistance of E. C. Murphy. 1914. 263 pp., 3 pls. 70c.

The results of an investigation which was carried on in a specially equipped laboratory at Berkeley, Cal., and was undertaken for the purpose of learning "the laws which control the movement of bed load and especially to determine how the quantity of load is related to the stream slope and discharge and to the degree of comminution of the débris."

A highly technical report.

105. Hydraulic mining débris in the Sierra Nevada, by G. K. Gilbert. 154 pp., 34 pls. 1917.

Presents the results of an investigation undertaken by the United States Geological Survey in response to a memorial from the California Miners' Association asking that a particular study be made of portions of the Sacramento and San Joaquin valleys affected by detritus from torrential streams. The report deals largely with geologic and physiographic aspects of the subject, traces the physical effects, past and future, of the hydraulic mining of earlier decades, the similar effects which certain other industries induce through stimulation of the erosion of the soil, and the influence of the restriction of the area of inundation by the construction of levees. Suggests cooperation by several interests for the control of the streams now carrying heavy loads of débris.

BULLETINS.

*32. Lists and analyses of the mineral springs of the United States (a preliminary study), by A. C. Peale. 1886. 235 pp.

Defines mineral waters, lists the springs by States, and gives tables of analyses so far as available.

*264. Record of deep-well drilling for 1904, by M. L. Fuller, E. F. Lines, and A. C. Veatch. 1905. 106 pp. 10c.

*298. Record of deep-well drilling for 1905, by M. L. Fuller and Samuel Sanford. 1906. 299 pp. 25c.

Bulletins 264 and 298 discuss the importance of accurate well records to the driller, to owners of oil, gas, and water wells, and to the geologist; describe the general methods of work; give tabulated records of wells by States, and detailed records selected as affording valuable stratigraphic information.

*319. Summary of the controlling factors of artesian flows, by Myron L. Fuller, 1908. 44 pp. 10c.

Describes underground reservoirs, the sources of underground waters, the confining agents, the primary and modifying factors of artesian circulation, the essential and modifying factors of artesian flow, and typical artesian systems.

*479. The geochemical interpretation of water analyses, by Chase Palmer. 1911. 31 pp. 5c.

Discusses the expression of chemical analyses, the chemical character of water and the properties of natural waters; gives a classification of waters based on property values and reacting values, and discusses the character of the waters of certain rivers as interpreted directly from the results of analyses; discusses also the relation of water properties to geologic formations, silica in river water, and the character of the water of the Mississippi and the Great Lakes and St. Lawrence River as indicated by chemical analyses.

616. The data of geochemistry (third edition), by F. W. Clarke. 1916. 821 pp. 45c.

Earlier editions were published as Bulletins 330 and 491. Contains a discussion of the statement and interpretation of water analyses and a chapter on "Mineral wells and springs" (pp. 179-216). Discusses the definition and classification of mineral waters, changes in the composition of water, deposits of calcareous, ocherous, and siliceous materials made by water, vadose and juvenile waters, and thermal springs in relation to volcanism. Describes the different kinds of ground water and gives typical analyses. Includes a brief bibliography of papers containing water analyses.

INDEX BY AREAS AND SUBJECTS.

[A—Annual Report; M—Monograph; B—Bulletin; P—Professional Paper; W—Water-Supply Paper; G F—Geologic folio.]

[1] Many of the reports contain brief subject bibliographies. See abstracts.
[2] Many analyses of river, spring, and well waters are scattered through publications, as noted in abstracts.

INDEX OF STREAMS.

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FRANKLIN K. LANE, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

WATER-SUPPLY PAPER 455

SURFACE WATER SUPPLY OF THE UNITED STATES 1917

PART V. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS

NATHAN C. GROVER, Chief Hydraulic Engineer
W. G. HOYT, District Engineer

Prepared in cooperation with the States of
MINNESOTA, WISCONSIN, IOWA, and ILLINOIS

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CONTENTS.

ILLUSTRATIONS.

SURFACE WATER SUPPLY OF HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS, 1917.

AUTHORIZATION AND SCOPE OF WORK.

This volume is one of a series of 14 reports presenting records of measurements of flow made on streams in the United States during the year ending September 30, 1917.

The data presented in these reports were collected by the United States Geological Survey under the following authority contained in the organic law (20 Stat. L., p. 394):

Provided, That this officer [the Director] shall have the direction of the Geological Survey and the classification of public lands and examination of the geological structure, mineral resources, and products of the national domain.

The work was begun in 1888 in connection with special studies relating to irrigation in the arid West. Since the fiscal year ending June 30, 1895, successive sundry civil bills passed by Congress have carried the following item and appropriations:

For gaging the streams and determining the water supply of the United States, and for the investigation of underground currents and artesian wells, and for the preparation of reports upon the best methods of utilizing the water resources.

Annual appropriations for the fiscal years ending June 30, 1895–1918.

1895	$12,500
1896	20,000
1897 to 1900, inclusive	50,000
1901 to 1902, inclusive	100,000
1903 to 1906, inclusive	200,000
1907	150,000
1908 to 1910, inclusive	100,000
1911 to 1918, inclusive	150,000

In the execution of the work many private and State organizations have cooperated either by furnishing data or by assisting in collecting data. Acknowledgments for cooperation of the first kind are made in connection with the description of each station affected; cooperation of the second kind is acknowledged on page 11.

Measurements of stream flow have been made at about 4,250 points in the United States and also at many points in Alaska and the Hawaiian Islands. In July, 1917, 1,180 gaging stations were being maintained by the Survey and the cooperating organizations. Many miscellaneous discharge measurements are made at other points. In connection with this work data were also collected in regard to precipitation, evaporation, storage reservoirs, river profiles, and water power in many sections of the country and will be made available in water-supply papers from time to time. Information in regard to publications relating to water resources is presented in the appendix to this report.

DEFINITION OF TERMS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups—(1) those that represent a rate of flow, as second-feet, gallons per minute, miner's inches, and discharge in second-feet per square mile, and (2) those that represent the actual quantity of water, as run-off in depth in inches, acre-feet, and millions of cubic feet. The principal terms used in this series of reports are second-feet, second-feet per square mile, run-off in inches, acre-feet, and millions of cubic feet. They may be defined as follows:

"Second-feet" is an abbreviation for "cubic feet per second." A second-foot is the rate of discharge of water flowing in a channel of rectangular cross section 1 foot wide and 1 foot deep at an average velocity of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off (depth in inches)" is the depth to which an area would be covered if all the water flowing from it in a given period were uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

An "acre-foot," equivalent to 43,560 cubic feet, is the quantity required to cover an acre to the depth of 1 foot. The term is commonly used in connection with storage for irrigation.

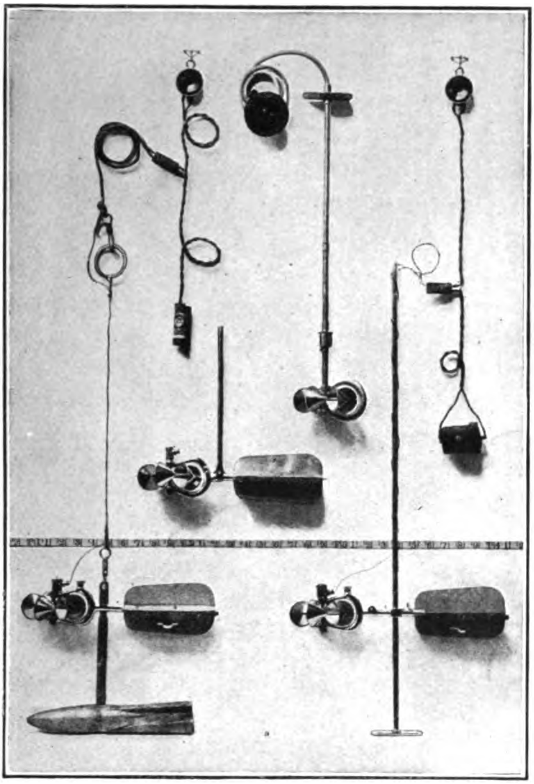
"Millions of cubic feet" is applied to quantities of water stored in reservoirs, most frequently in connection with studies of flood control.

The following terms not in common use are here defined:

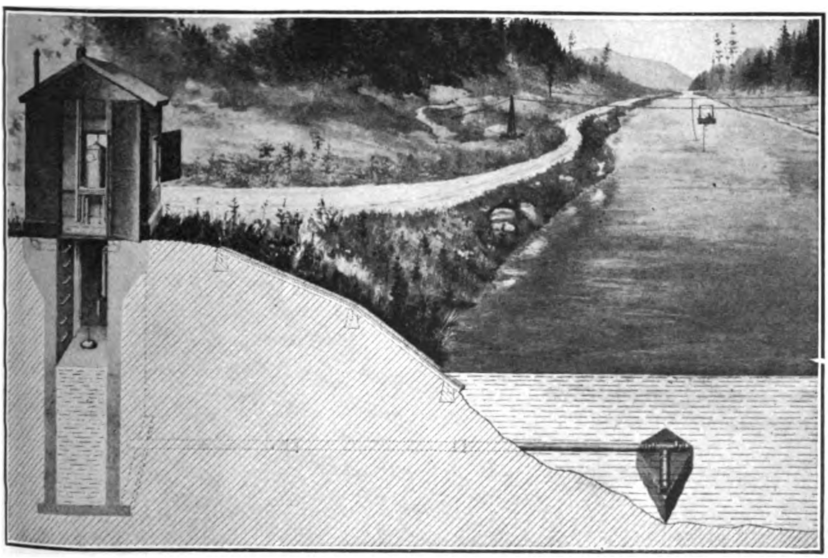
"Stage-discharge relation," an abbreviation for the term "relation of gage height to discharge."

"Control," a term used to designate the section or sections of the stream channel below the gage which determine the stage-discharge relation at the gage. It should be noted that the control may not be the same section or sections at all stages.

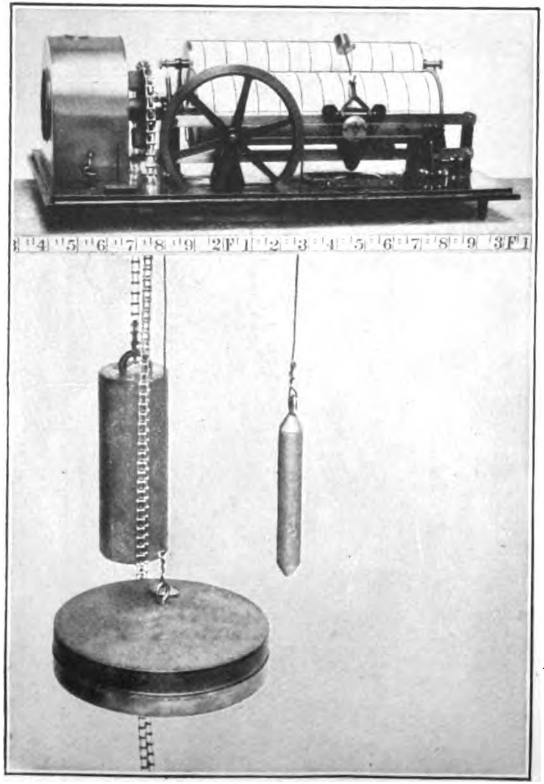
The "point of zero flow" for a gaging station is that point on the gage—the gage height—to which the surface of the river falls when the discharge is reduced to zero.



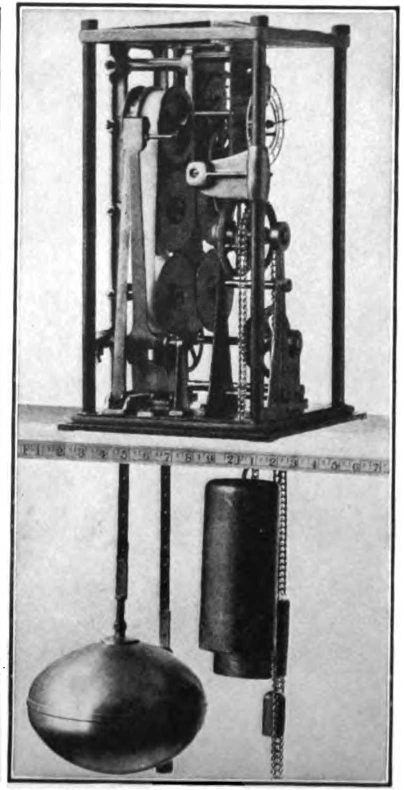
A. PRICE CURRENT METERS.



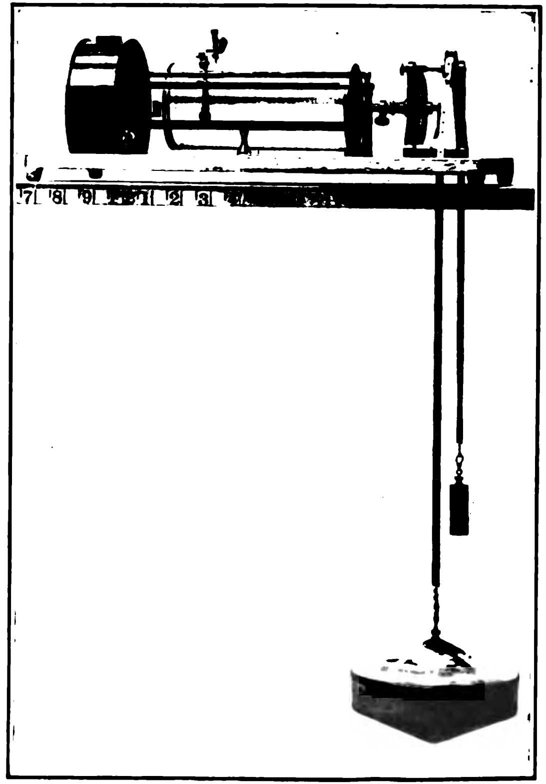
B. TYPICAL GAGING STATION.



A. STEVENS CONTINUOUS.



B. GURLEY PRINTING.



C. FRIEZ.

WATER-STAGE RECORDERS.

EXPLANATION OF DATA.

The data presented in this report cover the year beginning October 1, 1916, and ending September 30, 1917. At the beginning of January in most parts of the United States much of the precipitation in the preceding three months is stored as ground water in the form of snow or ice, or in ponds, lakes, and swamps, and this stored water passes off in the streams during the spring break-up. At the end of September, on the other hand, the only stored water available for run-off is possibly a small quantity in the ground; therefore the run-off for the year beginning October 1 is practically all derived from precipitation within that year.

The base data collected at gaging stations consist of records of stage, measurements of discharge, and general information used to supplement the gage heights and discharge measurements in determining the daily flow. The records of stage are obtained either from direct readings on a staff gage or from a water-stage recorder that gives a continuous record of the fluctuations. Measurements of discharge are made with a current meter. (See Pls. I, II.) The general methods are outlined in standard textbooks on the measurement of river discharge.

From the discharge measurements rating tables are prepared that give the discharge for any stage, and these rating tables, when applied to the gage heights, give the discharge from which the daily, monthly, and yearly means of discharge are determined.

The data presented for each gaging station in the area covered by this report comprise a description of the station, a table giving records of discharge measurements, a table showing the daily discharge of the stream, and a table of monthly and yearly discharge and run-off.

If the base data are insufficient to determine the daily discharge, tables giving daily gage height and records of discharge measurements are published.

The description of the station gives, in addition to statements regarding location and equipment, information in regard to any conditions that may affect the permanence of the stage-discharge relation, covering such subjects as the occurrence of ice, the use of the stream for log driving, shifting of control, and the cause and effect of backwater; it gives also information as to diversions that decrease the flow at the gage, artificial regulation, maximum and minimum recorded stages, and the accuracy of the records.

The table of daily discharge gives, in general, the discharge in second-feet corresponding to the mean of the gage heights read each day. At stations on streams subject to sudden or rapid diurnal fluctuation the discharge obtained from the rating table and the mean daily gage height may not be the true mean discharge for the day. If such stations are equipped with water-stage recorders the mean daily discharge may be obtained by averaging discharge at regular intervals during the day, or by using the discharge integrator, an instrument operating on the principle of the planimeter and containing as an essential element the rating curve of the station.

In the table of monthly discharge the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest. As the gage height is the mean for the day it does not indicate correctly the stage when the water surface was at crest height, and the corresponding discharge was consequently larger than given in the maximum column. Likewise, in the column headed "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow in cubic feet per second during the month. On this average flow computations recorded in the remaining columns, which are defined on page 8, are based.

The deficiency table presented for some of the gaging stations shows the number of days in each year on which the mean daily discharge was less than the discharge given in the table. By subtraction the table gives the number of days each year that the mean daily discharge was between the discharges given in the table and, also by subtraction, the number of days that the mean daily discharge was equal to or greater than the discharge given. If one discharge rating table was used throughout the period covered by the deficiency table, gage heights that correspond to the discharges are also given.

ACCURACY OF FIELD DATA AND COMPUTED RESULTS.

The accuracy of stream-flow data depends primarily (1) on the permanence of the stage-discharge relation and (2) on the accuracy of observation of stage, measurements of flow, and interpretation of records.

A paragraph in the description of the station gives information regarding the (1) permanence of the stage-discharge relation, (2) precision with which the discharge rating curve is defined, (3) refinement of gage readings, (4) frequency of gage readings, and (5) methods of applying daily gage heights to the rating table to obtain the daily discharge.[1]

For the rating tables "well defined" indicates, in general, that the rating is probably accurate within 5 per cent; "fairly well defined," within 10 per cent; "poorly defined," within 15 to 25 per cent. These notes are very general and are based on the plotting of the individual measurements with reference to the mean rating curve.

[1] For a more detailed discussion of the accuracy of stream-flow data see Grover, N. C., and Hoyt, J. C., Accuracy of stream-flow data: U. S. Geol. Survey Water-Supply Paper 400, pp. 53-59, 1916.

The monthly means for any station may represent with high accuracy the quantity of water flowing past the gage, but the figures showing discharge per square mile and depth of run-off in inches may be subject to gross errors caused by the inclusion of large non-contributing districts in the measured drainage area, by lack of information concerning water diverted for irrigation or other use, or by inability to interpret the effect of artificial regulation of the flow of the river above the station. "Second-feet per square mile" and "Run-off (depth in inches)" are therefore not computed if such errors appear probable. The computations are also omitted for stations on streams draining areas in which the annual rainfall is less than 20 inches. All figures representing "second-feet per square mile" and "run-off (depth in inches)" previously published by the Survey should be used with caution because of possible inherent sources of error not known to the Survey.

The table of monthly discharge gives only a general idea of the flow at the station and should not be used for other than preliminary estimates; the tables of daily discharge allow more detailed studies of the variation in flow. It should be borne in mind, however, that the observations in each succeeding year may be expected to throw new light on data previously published.

COOPERATION.

In Montana the work was done in cooperation with the United States Reclamation Service. The station on St. Mary River at Kimball, Alberta, was maintained in cooperation with the Canadian Department of Interior.

In Minnesota the work was carried on in cooperation with the State Drainage Commission, E. V. Willard, acting State drainage engineer, under terms of an act of the legislature of 1909 as embodied in joint resolution 19, which reads as follows:

> Whereas the water supplies, water powers, navigation of our rivers, drainage of our lands, and the sanitary condition of our streams and their watersheds generally form one great asset and present one great problem, therefore:
>
> *Be it resolved by the house of representatives, the senate concurring,* That the State drainage commission be, and is hereby, directed to investigate progress in other States toward the solution of said problem in such States, to investigate and determine the nature of said problems in this State.

The International Joint Commission maintained the water-stage recorder and paid the salary of the observer at the station on Kawishiwi River near Winton, and the United States Engineer Corps paid the salaries of the observers at the stations on Minnesota River near Montevideo and Chippewa River near Watson.

In Wisconsin the work was carried on in cooperation with the Railroad Commission of Wisconsin, C. M. Larson, chief engineer, and at certain stations with the following organizations: Wisconsin-

Minnesota Light & Power Co. (Chippewa River at Chippewa Falls, Red Cedar River near Colfax, Red Cedar River at Cedar Falls, Red Cedar River at Menomonie), Chippewa & Flambeau Improvement Co. (Chippewa River at Bishops Bridge near Winter), Stoughton Municipal Electric Light System (Yahara River near Edgerton).

In Iowa the work was carried on in cooperation with the Iowa Geological Survey, George F. Kay, director, and the Mississippi River Power Co., of Keokuk, Iowa.

In Illinois work was carried on in cooperation with the State of Illinois, through the Rivers and Lakes Commission until June 30, and the Division of Waterways of Public Works and Buildings afterward, and at single stations with the United States Army Engineer Corps (Illinois River at Peoria) and the Central Illinois Public Service Co. (South Fork of Sangamon River at power plant near Taylorville).

DIVISION OF WORK.

The data for stations in the Hudson Bay basin, except in Minnesota, were collected and prepared for publication under the direction of W. A. Lamb, district engineer, Helena, Mont., assisted by A. H. Tuttle and E. F. Chandler.

The data for stations in the Hudson Bay and Mississippi River basins in Minnesota were collected and prepared for publication under the direction of W. G. Hoyt, district engineer, assisted by S. B. Soulé and R. B. Kilgore, and by E. F. Chandler, assisted by T. M. Wardwell, L. B. Dale, and H. A. Noble.

For stations in the Mississippi River basin in Wisconsin the data were collected for publication under the direction of W. G. Hoyt, assisted by E. L. Williams, R. B. Kilgore, F. W. Huels, and J. P. Schwada.

For stations in the Mississippi River basin in Iowa the data were collected under the general direction of W. G. Hoyt and under the immediate direction of R. H. Bolster, assisted by C. Herlofson and A. Davis. The data for stations in the Mississippi River basin in Illinois were collected under the general direction of W. G. Hoyt and under the immediate direction of H. C. Beckman, assisted by G. J. Trinkaus. A. M. Wohl, H. S. Wohl, and Marcia Towle.

GAGING-STATION RECORDS.

HUDSON BAY DRAINAGE BASINS.

ST. MARY RIVER NEAR BABB, MONT.

[Including diversion from Swiftcurrent Creek.]

LOCATION.—About 1,040 feet above the headworks of St. Mary canal, one-fourth mile below outlet of Lower St. Mary Lake, and 2 miles south of Babb, on Blackfeet Indian Reservation, in Teton County.

DRAINAGE AREA.—278 square miles (including area of Swiftcurrent Creek above point of diversion into St. Mary Lake).

RECORDS AVAILABLE.—April 9, 1902, to September 30, 1917. Records prior to October, 1915, do not include the flow of Swiftcurrent Creek.

GAGE.—Chain gage on right bank. During the winter months a temporary low-water gage opposite the chain gage was read. Gages read by employees of the United States Reclamation Service.

DISCHARGE MEASUREMENTS.—Made from cable 560 feet below gage, or by wading. Until September, 1909, the cable was at a point about 300 feet downstream from its present location.

CHANNEL AND CONTROL.—Bed of stream practically permanent. Banks high and not subject to overflow. The concrete diversion dam for the St. Mary canal, located 1,040 feet below the gage, forms the control. The dam is provided with flashboard sluice gates near the canal headgates. Stage-discharge relation is permanent when the flashboards in the sluice gates remain at the level of the crest of the dam.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.60 feet June 10 and 11 (discharge, 4,160 second-feet); minimum discharge, 66 second-feet April 1.

1902–1917: Maximum stage estimated at 9.4 feet June 5, 1908 (discharge, 7,980 second-feet); minimum discharge, 20 second-feet, April 3–7, 1904.

ICE.—Stage-discharge relation affected by ice for short periods.

DIVERSIONS.—None.

REGULATION.—Natural storage in St. Mary Lakes. The flow of Swiftcurrent Creek was diverted into lower St. Mary Lake on October 1, 1915. The flow of this stream will be regulated by Sherburne Lake reservoir.

ACCURACY.—Stage-discharge relation permanent when flashboards in sluice gates of dam are kept at level of crest of dam. Four rating curves have been developed and used for the periods noted: October 1–10, fairly well defined; October 11 to December 4 and April 11–19, and July 23 to September 9, well defined; April 20 to July 22 and September 13–30, well defined; January 6 to April 5, poorly defined. Gage read twice daily during the open season and once daily in winter. Daily discharge ascertained by applying daily gage height to rating table except for periods affected by ice or by shifting control. Discharge, December 5 to January 5 estimated from temperature records and notes by observer. Records good.

The diversion dam below the gaging station was constructed by the United States Reclamation Service for the purpose of diverting water from St. Mary River into the St. Mary canal, which carries the water across the divide into the North Fork of Milk River. The water then flows in the natural channel of Milk River through Canada, and is finally used for irrigation in the Milk River Valley in Montana. The present capacity of the diversion canal is about 425 second-feet. A storage reservoir is being provided on Swiftcurrent Creek by constructing a dam at the outlet of Sherburne Lake. By means of a diversion channel connecting Swiftcurrent Creek and Lower St. Mary Lake, the run-off from Swiftcurrent Creek is made available for diversion through St. Mary canal.

Discharge measurements of St. Mary River near Babb, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Nov. 23	0.65	266	June 30	4.45	2,980
Jan. 27	—.55	85	July 19	3.58	1,950
Apr. 13	—.43	116	Aug. 16	1.75	630
June 15	4.82	3,320	Sept. 14	1.69	363

Daily discharge, in second-feet, of St. Mary River near Babb, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	462	177	154	108	89	81	66	205	2,840	2,770	1,010	511
2	462	188	150	106	89	81	70	205	2,840	2,720	932	507
3	444	183	171	103	89	81	73	205	2,620	2,690	860	467
4	426	227	159	102	89	81	73	205	2,620	2,730	849	463
5	409	171	150	100	81	81	73	205	2,510	2,800	778	463
6	392	171	146	97	81	81	79	205	2,510	2,840	750	433
7	360	171	143	97	73	81	86	205	2,510	2,880	750	430
8	330	171	140	97	73	81	93	250	2,950	2,840	750	398
9	301	211	139	97	70	81	100	300	3,500	2,740	750	398
10	287	196	138	89	70	81	107	415	3,940	2,690	750	388
11	236	183	138	97	73	81	114	620	4,160	2,550	740	377
12	245	183	137	97	73	81	114	770	4,160	2,580	700	366
13	265	183	137	97	77	81	119	1,020	3,830	2,510	675	355
14	245	183	136	97	81	81	119	1,460	3,500	2,390	655	385
15	255	171	136	97	81	81	124	1,760	3,280	2,200	650	385
16	265	227	135	97	81	81	128	2,400	3,390	1,940	650	385
17	245	337	135	97	81	81	128	2,620	3,610	1,860	650	385
18	255	352	134	97	81	81	128	2,620	3,880	1,860	650	367
19	311	287	134	89	81	81	133	2,620	3,940	1,960	650	367
20	337	245	133	89	81	81	125	2,620	4,000	1,960	650	355
21	471	245	133	89	81	81	125	2,510	3,940	1,900	660	355
22	452	245	132	89	81	81	165	2,510	3,940	1,840	675	355
23	366	255	132	89	81	81	165	2,180	3,830	1,740	700	355
24	287	219	131	89	81	81	165	2,070	3,660	1,560	690	355
25	245	236	131	89	81	81	165	2,180	3,610	1,460	655	355
26	190	190	130	85	81	81	165	2,620	3,500	1,340	645	355
27	171	171	130	85	81	81	205	2,950	3,390	1,280	630	355
28	180	171	127	89	81	73	205	3,060	3,220	1,250	605	355
29	190	165	125	89	....	73	205	3,280	3,060	1,250	563	355
30	177	154	122	89	....	73	205	3,280	2,900	1,170	520	355
31	190	....	110	89	....	73	....	3,170	....	1,220	520	....

NOTE.—No gage-height record Dec. 5 to Jan. 5; discharge estimated from temperature records and notes by observer. Discharge estimated because of ice for following periods: Jan. 21, 29–31, Feb. 1, 16–28, and Mar. 1–11. Discharge, Apr. 6–10, interpolated because of change in stage-discharge relation.

Monthly discharge of St. Mary River near Babb, Mont., for the year ending Sept. 30, 1917.

[Drainage area, 278[a] square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
October	471	171	305	1.10	1.27	18,800
November	352	154	209	.752	.84	12,400
December	171	110	137	.493	.57	8,420
January	108	89	94.2	.339	.39	5,790
February	89	70	80.1	.288	.30	4,450
March	81	73	80.1	.288	.33	4,920
April	205	66	127	.457	.51	7,560
May	3,280	205	1,640	5.90	6.80	101,000
June	4,160	2,510	3,390	12.2	13.61	202,000
July	2,880	1,170	2,110	7.59	8.75	130,000
August	1,010	520	700	2.52	2.90	43,300
September	511	355	391	1.41	1.57	23,300
The year	4,160	66	775	2.79	37.84	562,000

[a] Includes drainage area of Swiftcurrent Creek above point of diversion into St. Mary Lake.

ST. MARY RIVER NEAR KIMBALL, ALBERTA.

LOCATION.—In SW. ¼ sec. 25, T. 1 N., R. 25 W. fourth meridian, about 1 mile south of Kimball, Alberta, and 5 miles north of international boundary.

DRAINAGE AREA.—472 square miles (measured on topographic maps).

RECORDS AVAILABLE.—January 1, 1913, to September 30, 1917. From September 4, 1902, to December 31, 1912, records were obtained at a point one-fourth mile below the boundary line. Records were also obtained by the Irrigation Branch (now the Reclamation Service), Department of the Interior, Canada, at a point about half a mile below the present station, from 1905 to 1912. The discharge at the three points is practically the same.

GAGE.—Stevens water-stage recorder with a concrete well and shelter on the right bank used during the open-water season. A staff gage at cable from which discharge measurements were made was used October 1 to November 8. A chain gage attached to the highway bridge 2 miles below the station was used November 10 to May 5 when stage-discharge relation was affected by ice.

DISCHARGE MEASUREMENTS.—Made from a cable three-fourths of a mile below the gage; low-water measurements made by wading near the cable.

CHANNEL AND CONTROL.—Bed of stream at the gage and at the control is composed of boulders and sandstone ledges. The control is formed by an outcropping ledge of sandstone. Stage-discharge relation is affected by a large gravel bar which has formed on the right bank at the control.

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder, 6.93 feet at 6 p. m. June 11 (discharge, 5,230 second-feet); minimum discharge, 100 second-feet January 30 and 31.

1902–1917: Maximum stage recorded, 12.75 feet, June 5, 1908 (discharge, 18,000 second-feet, estimated by comparison with record for station near Babb); minimum discharge, 70 second-feet,[1] February 5, 1914.

ICE.—Stage discharge relation seriously affected by ice. Daily discharge computed from discharge measurements and temperature records.

DIVERSIONS.—The St. Mary canal, constructed by the United States Reclamation Service, diverts water from St. Mary River near Babb, Mont., to the North Fork of Milk River. During 1917, 33,600 acre-feet was diverted. The Alberta Railway & Irrigation Co. canal diverts from St. Mary River about a mile below the station.

REGULATION.—The flow of Swiftcurrent Creek will be regulated by the Sherburne Lake reservoir, under construction by the United States Reclamation Service.

ACCURACY.—Stage-discharge relation changed during high water June 9–13; affected by ice November 10 to May 5. Rating curves used as follows: October 1 to November 8, fairly well defined; May 7 to June 8, well defined between 470 and 4,000 second-feet; June 14 to September 30 well defined between 200 and 5,000 second-feet. Staff gage read to hundredths twice daily October 1 to November 9; chain gage read November 10 to May 5. Gage heights May 7 to September 30 obtained from recorder graph by averaging the stage for hourly intervals. Daily discharge ascertained by applying mean daily gage height to rating table except for periods during which stage-discharge relation was affected by shifting control or ice. Records good.

COOPERATION.—Station maintained jointly with the Reclamation Service, Department of the Interior of Canada.

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[1] Only estimates of mean monthly flow are available for the winter periods from 1902 to 1912, inclusive, and a lower minimum discharge may have occurred during that time.

Discharge measurements of St. Mary River near Kimball, Alberta, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 18	S. H. Frame[a]	[b] 3.23	342	May 24	A. W. P. Lowrie[a]	5.50	2,750
Nov. 17	.....do	4.25	440	26	.....do	5.96	3,290
18	W. A. Lamb	4.28	418	27	.....do	6.08	3,570
Dec. 11	H. W. Rowley[a]	3.95	210	28	.....do	6.20	3,720
Jan. 3	.....do	[c] 5.57	241	June 14	W. A. Lamb	6.15	4,070
22	.....do	[c] 5.38	118	18	A. W. P. Lowrie[a]	6.47	4,780
Feb. 20	G. S. Wendon[a]	[c] 5.76	140	19	.....do	6.44	4,750
Mar. 13	.....do	[c] 5.54	140	20	.....do	6.46	4,680
Apr. 2	A. W. P. Lowrie[a]	[c] 5.69	110	22	.....do	6.43	4,720
7	.....do	[c] 6.83	651	July 9	.....do	5.47	2,900
11	.....do	[c] 6.37	824	20	W. A. Lamb	4.85	1,870
12	.....do	[c] 5.98	597	26	A. W. P. Lowrie[a]	4.26	1,270
14	.....do	[c] 5.53	376	Aug. 23	.....do	3.00	494
May 3	.....do	3.11	504	Sept. 14	W. A. Lamb	2.94	454
7	.....do	3.18	562	18	A. W. P. Lowrie[a]	2.95	453

[a] Engineer, Reclamation Service, Department of Interior, Canada.
[b] Gage height referred to staff gage at cable.
[c] Gage height referred to chain gage on highway bridge 2 miles below regular station; stage-discharge relation affected by ice.

Daily discharge, in second-feet, of St. Mary River near Kimball, Alberta, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	511	300	245	239	100	132	110	547	3,470	3,130	837	332
2	483	325	235	241	100	131	110	568	3,350	3,100	772	294
3	469	336	245	240	102	130	110	581	3,280	2,970	708	268
4	455	336	245	240	103	130	250	588	3,140	3,060	672	253
5	442	320	230	240	104	130	375	634	3,080	3,020	610	247
6	469	305	225	240	106	130	530	664	3,050	3,040	560	236
7	422	295	220	240	108	130	650	570	3,180	3,060	538	230
8	448	325	215	240	112	131	690	660	3,520	2,990	538	222
9	455	350	210	240	120	133	735	818	3,880	2,830	546	250
10	442	310	210	239	128	135	780	1,110	4,610	2,850	551	318
11	422	280	210	235	134	138	824	1,410	5,200	2,730	560	318
12	378	280	210	227	136	140	597	1,660	5,090	2,680	515	386
13	360	280	210	214	140	140	485	2,050	4,940	2,600	470	458
14	360	280	210	194	150	140	376	2,500	4,600	2,530	458	470
15	348	290	210	170	155	140	372	2,850	4,410	2,330	434	462
16	336	340	210	150	160	140	370	3,040	4,430	2,160	434	454
17	342	440	210	140	160	140	372	3,220	4,690	2,100	430	450
18	348	418	210	132	155	140	374	3,200	4,760	2,100	426	450
19	378	396	210	124	146	140	384	3,170	4,760	2,160	430	450
20	390	355	210	120	140	140	410	3,220	4,740	1,890	438	450
21	410	340	210	120	140	138	438	3,140	4,760	1,850	452	442
22	390	340	210	120	140	137	450	2,890	4,690	1,820	466	442
23	378	345	215	120	139	134	460	2,640	4,510	1,720	470	430
24	348	342	215	123	138	130	466	2,510	4,240	1,570	462	470
25	348	333	215	128	136	128	472	2,780	4,140	1,440	446	458
26	330	323	220	128	134	125	477	3,380	4,100	1,320	418	450
27	342	312	220	120	132	122	481	3,560	3,940	1,210	390	456
28	330	296	225	112	132	120	468	3,740	3,820	1,130	378	442
29	330	278	230	105	....	117	475	3,840	3,510	1,090	354	434
30	330	260	235	100	....	115	517	3,950	3,240	1,010	318	430
31	336	....	237	100	....	111	....	3,680	....	928	340	....

NOTE.—Gage not read, discharge estimated for following days: Oct. 8, 29, Nov. 5, 9, 19, Dec. 3, 10, 17, 20, 24, 31, Jan. 1, 7, Mar. 11, 18, Apr. 22, 27, May 6 and 29.

Monthly discharge of St. Mary River near Kimball, Alberta, for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	511	330	391	24,000
November	440	260	324	19,300
December	245	210	220	13,500
January	241	100	174	10,700
February	160	100	123	6,830
March	140	111	132	8,120
April	824	110	454	27,000
May	3,950	547	2,230	137,000
June	5,200	3,050	4,100	244,000
July	3,130	928	2,210	136,000
August	837	318	497	30,600
September	470	222	382	22,700
The year	5,200	100	940	680,000

Combined daily discharge, in second-feet, of St. Mary River near Kimball, Alberta, and St. Mary canal at Douglas bridge, near Browning, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	511	309	245	239	100	132	110	547	3,470	3,130	1,090	594
2	483	325	235	241	100	131	110	568	3,350	3,100	1,030	556
3	469	336	245	240	102	130	110	581	3,280	3,060	970	530
4	455	336	245	240	103	130	250	588	3,140	3,160	984	515
5	442	320	230	240	104	130	375	634	3,080	3,200	872	509
6	469	305	225	240	106	130	530	664	3,050	3,250	822	467
7	422	295	220	240	108	130	650	570	3,180	3,270	800	471
8	448	325	215	240	112	131	690	660	3,520	3,200	800	463
9	455	350	210	240	120	133	735	818	3,880	3,060	808	491
10	442	310	210	239	128	136	780	1,110	4,610	3,080	813	519
11	422	280	210	235	134	138	824	1,410	5,200	2,970	822	464
12	378	280	210	227	136	140	507	1,660	5,090	2,910	777	540
13	360	280	210	214	140	140	485	2,050	4,940	2,830	732	596
14	360	280	210	194	150	140	376	2,500	4,600	2,760	720	470
15	348	290	210	170	155	140	372	2,850	4,410	2,560	696	462
16	336	340	210	150	160	140	370	3,040	4,430	2,390	696	454
17	342	440	210	140	160	140	372	3,220	4,690	2,330	692	450
18	348	418	210	132	155	140	374	3,200	4,760	2,330	688	450
19	378	395	210	124	146	140	384	3,170	4,760	2,390	692	450
20	390	355	210	120	140	140	410	3,220	4,740	2,130	700	450
21	410	340	210	120	140	138	438	3,140	4,760	2,090	714	442
22	390	340	210	120	140	137	450	2,890	4,690	2,060	728	442
23	378	345	215	120	139	134	460	2,640	4,510	1,980	732	430
24	348	342	215	123	138	130	466	2,510	4,240	1,830	724	470
25	348	333	215	128	136	128	472	2,780	4,140	1,700	708	458
26	330	323	320	128	134	125	477	3,380	4,100	1,570	680	450
27	342	312	220	120	132	122	481	3,560	3,940	1,460	652	458
28	330	296	225	112	132	120	468	3,740	3,820	1,380	640	442
29	330	278	230	105	....	117	475	3,840	3,510	1,340	616	434
30	330	260	235	100	....	115	517	3,950	3,240	1,260	580	430
31	336	....	237	100	....	111	....	3,680	....	1,180	602	....

NOTE.—For table of daily discharge of St. Mary canal at Douglas bridge, see p. 22.

Combined monthly discharge of St. Mary River near Kimball, Alberta, and St. Mary canal at Douglas bridge near Browning, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	511	330	391	24,000
November	440	260	324	19,300
December	245	210	220	13,500
January	241	100	174	10,700
February	160	100	123	6,830
March	140	111	132	8,120
April	824	110	454	27,000
May	3,950	547	2,230	137,000
June	5,200	3,050	4,100	244,000
July	3,270	1,180	2,420	149,000
August	1,090	580	759	46,700
September	596	430	479	28,500
The year	5,200	100	988	715,000

NOTE.—For table of monthly discharge of St. Mary canal at Douglas bridge, see p. 22.

SWIFTCURRENT CREEK AT MANY GLACIER, MONT.

LOCATION.—In sec. 12, T. 35 N., R. 16 W., at outlet of McDermott Lake at Many Glacier, in Glacier National Park, about 14 miles southwest of Babb, in Teton County.

DRAINAGE AREA.—31.4 square miles (measured on topographic map).

RECORDS AVAILABLE.—June 6, 1912, to September 30, 1917.

GAGE.—Vertical staff on the right bank at the outlet of the lake. Prior to May 23, 1916, a staff gage on the left bank opposite the present gage was read. Gage read by George Hall.

DISCHARGE MEASUREMENTS.—Made by wading at the outlet of the lake or below the falls. High-water measurements made from the highway bridge above the power house; measuring section at the bridge very poor.

CHANNEL AND CONTROL.—Control is a limestone outcrop at the outlet of the lake.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 4.20 feet at 6 p. m. June 9 (discharge, 1,220 second-feet); minimum discharge, 20 second-feet, by current-meter measurement, April 14, when stage-discharge relation was seriously affected by ice. No record of discharge January 1 to April 13.

1912–1917: Maximum stage recorded, 4.75 feet, June 17, 1916 (discharge, 1,550 second-feet); minimum discharge, 10.8 second-feet, March 19, 1912, measured by current meter.

ICE.—Stage-discharge relation seriously affected by ice January 1 to April 17. Ice cover on lake November 20 to June 9; records for December may be slightly in error on account of ice.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation probably permanent during year; seriously affected by ice. Rating curve used October 1 to December 31, and April 18 to September 30, well defined between 44 and 825 second-feet, but no current-meter measurements were made during open season. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Discharge, April 14, obtained from current-meter measurement of that date; April 15–17 interpolated because of ice. Records probably fair, but owing to lack of discharge measurements should be used with caution.

The following discharge measurement was made by W. A. Lamb: April 14, 1917: Gage height, 1.48 feet; discharge, 19.6 second-feet (stage-discharge relation affected by ice).

Daily discharge, in second-feet, of Swiftcurrent Creek at Many Glacier, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	70	63	55	....	48	292	525	152	112
2	67	67	54	....	47	470	545	149	112
3	67	68	55	....	48	445	570	144	107
4	63	70	55	....	45	410	570	133	101
5	62	73	54	....	46	415	545	128	94
6	60	71	53	....	47	485	555	128	86
7	60	70	53	....	55	580	565	138	73
8	60	68	52	....	76	759	520	128	78
9	59	71	52	....	97	1,160	525	128	84
10	58	68	48	....	133	1,020	525	133	81
11	58	65	47	....	228	610	530	125	84
12	55	63	46	....	315	510	460	138	90
13	55	62	46	....	440	386	450	149	84
14	53	60	45	20	580	435	386	159	86
15	53	60	44	26	908	470	376	159	92
16	54	60	44	32	610	825	372	159	97
17	58	58	44	39	600	1,110	381	165	107
18	62	55	42	47	400	630	372	168	105
19	63	55	42	48	362	715	391	172	101
20	60	53	40	48	343	676	391	175	95
21	56	54	40	50	353	615	410	172	95
22	55	54	40	51	348	635	343	168	95
23	56	53	41	51	400	570	329	159	95
24	58	53	40	52	485	475	292	152	107
25	60	53	36	53	575	671	274	141	103
26	62	54	35	53	585	676	260	133	90
27	63	53	37	54	575	655	220	130	92
28	63	54	39	55	595	595	212	125	97
29	64	56	42	53	570	575	201	125	97
30	65	58	44	50	450	515	193	121	92
31	65	....	40	....	362	....	172	116	....

NOTE.—Stage-discharge relation seriously affected by ice, Jan. 1 to Apr. 17; data inadequate for determination of discharge Jan. 1 to Apr. 13.

Monthly discharge of Swiftcurrent Creek at Many Glacier, Mont., for the year ending Sept. 30, 1917.

[Drainage area, 31.4 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
October	70	53	60.1	1.91	2.20	3,700
November	73	53	60.7	1.93	2.16	3,610
December	55	35	45.3	1.44	1.66	2,790
April 14-30	55	20	46.0	1.46	.92	1,550
May	908	45	346	11.0	12.68	21,300
June	1,160	292	613	19.5	21.76	36,500
July	570	172	402	12.8	14.76	24,700
August	175	116	144	4.59	5.29	8,850
September	112	73	94.4	3.01	3.36	5,620

SWIFTCURRENT CREEK AT SHERBURNE, MONT.

LOCATION.—In sec. 35, T. 36 N., R. 15 W., near outlet of Lower Sherburne Lake, in Teton County.

DRAINAGE AREA.—64 square miles (measured on topographic map).

RECORDS AVAILABLE.—July 1, 1912, to September 30, 1917.

GAGE.—Staff gage on left bank about 300 feet below the spillway of the Sherburne Lake dam; read by employees of the United States Reclamation Service. From July 1, 1912, to November 9, 1914, a vertical staff gage was maintained on the left bank near the outlet of the lake, and at a different datum from the present gage.

DISCHARGE MEASUREMENTS.—Made by wading or from cable 50 feet below gage.

CHANNEL AND CONTROL.—An outcropping limestone ledge, somewhat broken and irregular, forms the control; subject to slight shifts.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 5.55 feet June 9–11 (discharge 1,070 second-feet); minimum stage 0.40 foot at 8 a. m. May 4 (discharge 6 second-feet).

1912–1917: Maximum stage recorded 7.85 feet June 17, 1916 (discharge 2,280 second-feet); minimum stage 0.5 foot April 25, 1916 (discharge 4 second-feet).

ICE.—Stage-discharge relation not seriously affected by ice.

DIVERSION.—None.

REGULATION.—The natural flow of the stream was affected by placing and removing flashboards on the temporary construction dam built at the outlet in connection with the Sherburne Lake storage dam.

ACCURACY.—Stage-discharge relation changed probably March 27. Rating curves used October 1 to March 27 and March 28 to September 30 are well defined. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Swiftcurrent Creek at Sherburne, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Gage.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Nov. 22	1.46	58	June 14	5.20	914	Aug. 17	2.30	154
Apr. 13	1.28	50	30	4.39	636	Sept. 13	1.82	85
May 17	5.25	970	July 20	3.96	515			

Daily discharge, in second-feet, of Swiftcurrent Creek at Sherburne, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	65	56	30	18	22	18	30	60	584	646	202	118
2	65	65	34	14	20	18	30	64	646	646	173	118
3	65	65	38	15	18	18	30	27	646	646	145	112
4	70	76	39	15	20	15	28	6	646	712	98	104
5	76	70	42	19	21	14	36	8	614	712	69	100
6	58	70	45	19	20	15	36	12	614	712	73	94
7	56	81	45	18	23	15	36	40	746	712	159	55
8	56	70	43	18	22	14	43	97	930	678	236	56
9	56	81	39	18	21	14	43	420	1,010	646	202	62
10	56	76	38	18	22	14	47	420	1,070	614	187	68
11	56	58	36	19	23	14	49	504	1,070	584	145	75
12	56	51	33	21	24	15	53	526	1,060	584	145	77
13	58	54	32	21	24	13	51	646	1,010	584	145	89
14	48	60	32	22	22	13	49	712	970	420	145	124
15	56	210	30	24	21	13	51	818	892	300	145	138
16	46	349	29	24	24	13	51	990	892	420	159	131
17	42	281	27	22	24	13	49	990	970	446	159	118
18	46	166	27	20	21	12	48	892	1,010	854	159	118
19	56	113	27	20	21	12	48	864	1,040	554	173	118
20	76	81	29	20	21	15	49	782	1,010	498	187	118
21	106	65	29	18	21	15	55	712	1,010	472	202	112
22	9	54	29	18	21	17	60	472	1,010	472	202	106
23	7	51	28	18	21	18	62	420	970	370	187	106
24	7	42	27	18	20	16	65	370	930	322	187	106
25	9	42	26	19	21	15	66	584	892	322	173	112
26	12	42	26	19	21	16	69	782	892	286	159	112
27	18	38	25	19	21	26	65	782	854	256	159	112
28	24	36	24	25	20	25	62	782	678	278	106	112
29	70	32	24	24	......	28	59	818	614	300	106	112
30	54	34	21	25	......	28	57	782	646	236	106	112
31	60	......	21	22	......	29	......	678	......	218	112	......

Monthly discharge of Swiftcurrent Creek at Sherburne, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	106	7	50.0	3,070
November	349	32	85.6	5,090
December	45	21	31.4	1,930
January	25	14	19.7	1,210
February	24	18	21.4	1,190
March	29	12	16.8	1,030
April	69	28	49.2	2,930
May	990	6	510	31,400
June	1,070	584	863	51,400
July	712	218	489	30,100
August	236	69	155	9,530
September	138	55	103	6,130
The year	1,070	6	200	145,000

U. S. RECLAMATION SERVICE ST. MARY CANAL AT HUDSON BAY DIVIDE, NEAR BROWNING, MONT.

Location.—At Douglas bridge on the Hudson Bay divide, 3 miles above the outlet of the canal, 30 miles directly north of Browning on the Blackfeet Indian Reservation.

Records available.—July 3 to September 13, 1917.

Gage.—A vertical staff, graduated to tenths, nailed to upstream side of left pier of bridge; read by U. S. Reclamation Service ditch rider.

Discharge measurements.—Made from upstream side of bridge at the gage.

Channel and control.—The channel is uniform, but the slope varies with the stage. Control is a V-shaped concrete drop 1 mile below the gage.

EXTREMES OF DISCHARGE.—Maximum discharge during the year 254 second-feet.

REGULATION.—The flow is regulated at the headgates 26 miles above. A small reservoir at Spider Lake serves to equalize sudden changes at the headgates.

ACCURACY.—Stage-discharge relation practically permanent. Gage read to tenths once daily. Discharge computed by using a rating curve based on discharge measurements made in 1918 and measurements of North Fork of Milk River at Peter's Ranch below the outlet of the canal. Records fair.

St. Mary canal diverts from St. Mary River near Babb, Mont., and carries the water across the divide into North Fork of Milk River. The water is used for irrigation in the Milk River valley in Montana.

Daily discharge, in second-feet, of U. S. Reclamation Service St. Mary canal at Hudson Bay divide, near Browning, Mont., for the year ending Sept. 30, 1917.

Day	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.
1	......	243	254	11	233	254	138	21	233	254	......
2	......	254	254	12	223	254	146	22	233	254	......
3	86	254	254	13	223	254	130	23	254	254	......
4	91	254	254	14	223	254	......	24	254	254	......
5	173	254	254	15	223	254	......	25	254	254	......
6	203	254	223	16	223	254	......	26	243	254	......
7	203	254	233	17	223	254	......	27	243	254	......
8	203	254	233	18	223	254	......	28	243	254	......
9	223	254	233	19	223	254	......	29	243	254	......
10	223	254	193	20	228	254	......	30	243	254	......
								31	243	254	......

NOTE.—No flow in canal Oct. 1 to July 2 and Sept. 14-30.

Monthly discharge of U. S. Reclamation Service St. Mary canal at Hudson Bay divide, near Browning, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
July 3-31	254	86	218	12,500
August	254	243	254	15,600
September 1-13	254	130	215	5,540
The year	....	....	....	33,600

OTTERTAIL RIVER AT GERMAN CHURCH, NEAR FERGUS FALLS, MINN.

LOCATION.—At highway bridge on south line of sec. 31, T. 134 N., R. 42 W., about 5 miles upstream from old station known as "Ottertail River, near Fergus Falls," and about 8 miles north of Fergus Falls, Ottertail County.

DRAINAGE AREA.—1,300 square miles.

RECORDS AVAILABLE.—October 29, 1913, to September 30, 1917, when station was discontinued. May 9, 1904, to October 22, 1913, records were collected at a station about 5 miles downstream from the present site. The drainage area at the lower station is only 10 square miles larger than at the upper, and no tributaries intervene.

GAGE.—Chain gage attached to the downstream handrail near the right bank; read by D. S. Danielson.

DISCHARGE MEASUREMENTS.—Made from downstream side of the bridge.

CHANNEL AND CONTROL.—Bed composed of sand, gravel, and boulders. Rapids about 100 feet below the gage form a well-defined control, which is practically permanent except for an occasional slight growth of vegetation in the channel. Banks at and above the gage are high; probably not subject to overflow. At the control the land adjacent to the left bank is low and will be overflowed at a stage of about 5 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.45 feet October 2, 3, 12, and 13 (discharge, 613 second-feet); minimum stage recorded, 0.88 foot Sept. 10 and 11 (discharge, about 121 second-feet).

1914–1917: Maximum stage recorded, 3.0 feet at 8.30 a. m. June 29, 1916 (discharge, 982 second-feet); minimum stage recorded September 10, 11, 1917.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—Fluctuations caused by the operation of a number of dams and small mills above the station are equalized by small lakes through which the river flows before reaching the station, so that they are not observable at the gage.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 237 and 837 second-feet; extended and subject to error outside these limits. Gage read to quarter-tenths once daily; fluctuations in stage so gradual that good results are obtained from one reading a day. Daily discharge ascertained by applying daily gage height to rating table except for period when stage-discharge relation was affected by ice, for which it was obtained by applying to rating table daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open water records excellent, except those for low stages, which are subject to error; winter records good.

Discharge measurements of Ottertail River at German Church, near Fergus Falls, Minn., during the year ending Sept. 30, 1917.

[Made by S. B. Soulé.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 29 a	3.07	324	Mar. 8 a	3.95	239
Jan. 26 a	3.39	284	June 29	1.84	340

a Complete ice cover.

Daily discharge, in second-feet, of Ottertail River at German Church, near Fergus Falls, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	613	584	480	320	280	250	355	530	480	327	200	137
2	613	584	480	320	280	250	360	530	480	307	200	137
3	613	584	455	320	280	250	375	530	480	307	196	137
4	598	584	435	320	280	250	380	530	457	304	196	134
5	584	584	415	315	275	250	385	530	434	304	192	130
6	584	584	415	315	275	245	390	530	434	300	188	127
7	584	584	390	315	275	240	392	530	434	294	185	130
8	584	584	390	310	275	240	392	530	434	286	181	130
9	584	584	390	310	275	240	392	530	434	277	177	127
10	584	584	390	310	270	240	392	530	434	277	173	121
11	584	557	385	305	270	240	392	530	434	277	173	121
12	613	557	385	305	270	245	413	530	434	272	169	130
13	613	557	380	305	265	250	434	530	413	272	166	130
14	584	530	380	305	265	250	392	530	392	266	166	134
15	584	530	375	305	265	250	402	530	392	266	169	130
16	584	530	375	300	260	250	413	530	392	266	166	128
17	584	530	370	300	260	255	434	530	392	266	166	127
18	584	530	370	300	260	260	434	544	392	261	162	127
19	584	530	365	300	260	270	457	557	392	251	158	144
20	584	530	365	300	260	275	457	530	392	251	151	144
21	584	530	360	295	255	280	480	530	373	242	147	142
22	584	505	360	290	255	290	480	530	362	238	147	140
23	584	480	360	290	250	300	480	530	354	233	144	140
24	584	455	355	285	250	305	530	530	354	233	140	153
25	584	455	350	285	250	310	557	530	354	233	140	166
26	584	434	340	285	250	320	530	530	354	214	140	169
27	584	415	335	280	250	330	530	530	347	196	137	169
28	584	390	330	280	250	335	530	530	347	208	137	166
29	584	415	325	280	....	340	530	530	347	208	134	154
30	584	480	325	280	....	350	530	530	347	208	134	154
31	584	....	320	280	....	355	....	557	....	208	137	....

NOTE.—Stage-discharge relation affected by ice Nov. 22 to Apr. 6. Gage not read, discharge interpolated Oct. 1, 4, 6, 8, 22, 29, Nov. 5, 19, Apr. 8, 15, 22, 27, 29, May 1, 6, 9, 11, 13, 15, 18, 23, 27, June 10, 15, 24, July 1, 8, 15, 22, 26, 29, Sept. 16 and 24.

Monthly discharge of Ottertail River at German Church, near Fergus Falls, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 1,300 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	613	584	589	0.453	0.52
November	584	390	526	.405	.45
December	480	320	379	.292	.34
January	320	280	300	.231	.27
February	280	250	265	.204	.21
March	355	240	275	.212	.24
April	557	355	441	.339	.38
May	557	530	532	.409	.47
June	480	347	402	.309	.34
July	327	196	260	.200	.23
August	200	134	164	.126	.14
September	169	121	139	.107	.12
The year	613	121	356	.274	3.71

RED RIVER AT FARGO, N. DAK.

Location.—At dam half a mile above highway bridge connecting Front Street, Fargo, N. Dak., with Moorhead, Minn., 10 miles above mouth of Sheyenne River.

Drainage area.—6,020 square miles.

Records available.—May 27, 1901, to September 30, 1917.

Gage.—Vertical staff attached to tree on left bank about 6 rods above the dam; vertical staff for use at low stages attached to upper end of fishway at left end of dam; lowest point of crest of dam now about 0.90 foot above datum of gage. Prior to September 1, 1914, gage readings were obtained from a vertical staff attached to the breakwater for the center pier of the Front Street bridge; this gage is still maintained and used by the Weather Bureau but can not be read accurately without a field glass and its control is less permanent than that of the gage now used. The datum of the Front Street gage is such that if the dam were removed, or if the stage were so high as to completely drown the dam, readings on the Front Street gage would be about 10.4 feet greater than on the gage now used. At extreme low stage the fall over the dam is about 5 feet.

Discharge measurements.—Made from footbridge a few feet upstream from gage.

Channel and control.—Bed consists of clay and silt; nearly permanent. Dam below gage is the control.

Extremes of discharge.—Maximum stage during year, 14.0 feet April 4 (discharge, 5,200 second-feet); minimum stage, 1.25 feet September 15 (discharge, 42 second-feet).

1901–1917: Maximum stage recorded, 19.9 feet April 6, 1916, when stage-discharge relation was affected by ice; maximum discharge, 7,440 second-feet April 7, 1916; minimum stage recorded, 5.7 feet November 1, 1910 (discharge, 36 second-feet).

Ice.—Stage-discharge relation not seriously affected by ice during winter; open-season rating table is applicable by making small correction for slight obstruction of crest of dam; in determining flow during spring break-up, however, corrections amounting to several feet must be applied to gage heights before applying open-season rating table, owing to backwater from ice.

Diversions.—None.

Regulation.—No power plants or storage above the station within 60 miles; storage not great enough to noticeably affect the discharge at the station.

ACCURACY.—Stage-discharge relation practically permanent during year except as affected by ice. Rating curve well defined between 200 and 2,400 second-feet and fairly well defined at other stages. Gage read to hundredths daily. Open-water records good.

Discharge measurements of Red River at Fargo, N. Dak., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 23	L. B. Dale	2.88	513	June 13	A. Hulteng	3.24	786
Apr. 7	E. F. Chandler	10.64	4,180	July 14	E. F. Chandler	2.39	323
14	T. M. Wardwell	5.22	2,820	Aug. 16	.....do	1.69	143
15	.....do	5.03	2,210				

Daily discharge, in second-feet, of Red River at Fargo, N. Dak., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,240	876		4,840	2,710	976	486	231	92
2	1,240	876		5,000	2,710	942	465	200	92
3	1,240	876		5,200	2,710	925	465	170	92
4	1,200	876		5,200	2,800	908	444	156	92
5	1,160	876		5,000	2,710	844	424	194	104
6	1,160	876		4,680	2,570	844	424	231	116
7	1,120	876		4,160	2,430	844	404	200	70
8	1,090	876		3,880	2,230	814	395	170	70
9	1,090	876		3,760	2,230	814	385	142	81
10	1,090	876		3,480	2,130	783	366	129	92
11	1,010	876		3,110	2,030	756	348	170	70
12	1,010	727		2,800	1,930	756	330	170	60
13	1,010	600		2,710	1,880	756	330	170	60
14	1,010	424		2,530	1,830	756	330	170	50
15	1,010	424		2,380	1,830	756	330	156	42
16	1,010	424		2,230	1,730	784	330	142	79
17	976	444		2,230	1,640	756	296	142	116
18	976			2,130	1,600	727	296	142	116
19	976			2,130	1,550	700	279	135	142
20	976			2,230	1,500	674	279	129	129
21	942			2,230	1,460	624	279	116	70
22	942			2,480	1,420	624	279	116	50
23	942			2,620	1,290	600	279	104	77
24	976			2,620	1,290	576	279	104	104
25	976			2,530	1,240	553	263	92	81
26	976		784	2,430	1,200	530	263	98	104
27	942		1,640	2,530	1,160	486	263	104	104
28	908		3,180	2,710	1,120	508	231	92	104
29	908		3,920	2,710	1,050	530	231	92	116
30	876		4,440	2,710	1,010	508	231	92	136
31	876		4,640		976		231	92	

Monthly discharge of Red River at Fargo, N. Dak., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	1,240	876	1,030	63,300
November 1-17	876	424	746	25,200
March 26-31	4,640	784	3,100	36,900
April	5,200	2,130	3,180	189,000
May	2,800	976	1,810	111,000
June	976	486	722	43,000
July	486	231	330	20,300
August	231	92	144	8,850
September	142	42	90.4	5,380

RED RIVER AT GRAND FORKS, N. DAK.

LOCATION.—At Northern Pacific Railway bridge between Grand Forks, N. Dak., and East Grand Forks, Minn., half a mile below mouth of Red Lake River.

DRAINAGE AREA.—25,000 square miles.

RECORDS AVAILABLE.—May 26, 1901, to September 30, 1917. Gage-height records have been kept by the United States Engineer Corps since 1882 and a few discharge measurements were made by them in early years.

GAGE.—Chain gage attached to Northern Pacific Railway bridge and vertical staff gage attached to ice breaker below center pier of same bridge. The staff gages used by the United States Engineer Corps and the United States Weather Bureau are on the bridge breakwater at the same place as the staff gage used by the United States Geological Survey and at datum 5 feet higher.

DISCHARGE MEASUREMENTS.—Made from Great Northern Railway bridge about a fifth of a mile above the gage.

CHANNEL AND CONTROL.—Clay and silt; shifts very slightly.

EXTREMES OF DISCHARGE.—Maximum stage during year, 33.9 feet at 5 p. m. April 8 (discharge, 21,600 second-feet); minimum stage, 3.4 feet September 4 (discharge, 395 second-feet).

1882-1917: Maximum stage recorded, 50.2 feet April 10, 1897 (discharge, 43,000 second-feet); minimum stage, 2.6 feet February 10, 1912 (discharge, 100 second-feet).

ICE.—Stage-discharge relation seriously affected by ice. The ice cover is usually complete and smooth from late in November until about the beginning of April, and the flow is steady, with few fluctuations. Since 1905 sufficient discharge measurements have been made each winter to obtain fairly accurate summaries of winter flow. For a few days or weeks at the time of the spring break-up the water level is raised considerably by ice in the channel, and at times, as indicated by a few discharge measurements, this abnormal rise has been as much as 8 feet, though usually it is less; correction is made for this rise in applying open-season rating table.

DIVERSION AND REGULATION.—No power plants above station with sufficient storage to cause noticeable variations in the flow.

ACCURACY.—Stage-discharge relation practically permanent during the year except as affected by ice. Rating curve fairly well defined between 400 and 9,000 second-feet. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for period in which stage-discharge relation was affected by ice, for which it was obtained by applying to rating table daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good; winter records fair.

Discharge measurements of Red River at Grand Forks, N. Dak., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 22	Chandler and Dale	8.09	1,280	Apr. 16	Wardwell and Dale	20.48	10,600
Jan. 18	Wardwell and Dale	8.16	1,260	May 7	Wardwell and Hulteng	14.48	5,990
Feb. 24	.....do	7.34	850	July 11	Chandler and Hulteng	6.11	1,410
Mar. 19	.....do	7.83	1,000				

Daily discharge, in second-feet, of Red River at Grand Forks, N. Dak., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	3,480	2,940	2,440	1,390	1,050	920	11,400	6,780	2,780	1,520	824	446
2	3,420	2,940	2,340	1,300	1,030	934	13,200	6,630	2,720	1,480	789	420
3	3,420	2,940	2,280	1,260	1,010	950	14,800	6,700	2,610	1,440	754	420
4	3,480	3,000	2,280	1,300	1,010	960	16,800	6,700	2,560	1,340	720	395
5	3,420	3,060	2,340	1,300	1,010	972	19,000	6,700	2,500	1,300	720	420
6	3,420	3,060	2,340	1,260	1,010	990	19,700	6,630	2,450	1,390	687	420
7	3,420	3,060	2,340	1,210	1,010	1,010	19,400	6,490	2,450	1,440	687	420
8	3,420	3,060	2,280	1,170	1,010	1,030	20,200	6,280	2,390	1,300	654	446
9	3,360	3,060	2,220	1,190	970	1,050	17,300	6,000	2,340	1,340	654	446
10	3,300	3,000	2,170	1,210	934	1,080	16,100	5,860	2,280	1,340	622	446
11	3,240	2,880	2,070	1,220	900	1,100	15,200	5,650	2,280	1,300	622	420
12	3,120	2,830	1,970	1,240	860	1,130	14,400	5,380	2,220	1,300	622	446
13	3,060	2,780	1,870	1,260	880	1,090	13,400	5,050	2,280	1,300	622	473
14	3,000	2,660	1,770	1,260	900	1,090	12,300	4,790	2,280	1,300	591	473
15	2,940	2,500	1,670	1,260	920	1,090	11,400	4,660	2,220	1,260	591	473
16	2,880	2,390	1,570	1,260	934	1,090	10,700	4,460	2,170	1,260	591	473
17	2,830	2,500	1,480	1,280	930	1,130	9,940	4,340	2,170	1,170	591	501
18	2,830	2,610	1,460	1,300	920	1,090	9,260	4,140	2,120	1,130	591	501
19	2,830	2,720	1,460	1,260	900	1,090	8,440	4,020	2,120	1,090	591	501
20	2,830	2,720	1,440	1,210	897	1,130	7,900	3,900	2,170	1,060	560	530
21	2,830	2,780	1,370	1,190	880	1,170	7,680	3,840	2,120	1,060	530	591
22	2,780	2,720	1,300	1,170	870	1,210	7,520	3,720	2,070	1,010	530	754
23	2,720	2,720	1,340	1,170	860	1,260	7,300	3,600	2,020	1,010	501	860
24	2,720	2,720	1,340	1,170	824	1,340	7,150	3,540	1,970	972	501	897
25	2,780	2,660	1,340	1,170	840	1,480	7,150	3,420	1,870	1,010	501	897
26	2,830	2,610	1,390	1,170	860	1,770	7,000	3,360	1,820	1,010	501	897
27	2,780	2,560	1,390	1,170	880	2,280	6,850	3,300	1,770	897	473	789
28	2,830	2,500	1,440	1,130	900	3,120	6,700	3,240	1,720	897	473	720
29	2,880	2,560	1,440	1,090	....	4,720	6,720	3,120	1,670	860	473	687
30	2,880	2,500	1,440	1,070	....	6,630	6,750	2,940	1,620	860	473	687
31	2,940	....	1,440	1,050	....	8,760	....	2,830	....	824	473	....

NOTE.—Stage-discharge relation affected by ice Nov. 11 to Apr. 17.

Monthly discharge of Red River at Grand Forks, N. Dak., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	3,480	2,720	3,060	188,000
November	3,060	2,390	2,770	165,000
December	2,440	1,300	1,780	109,000
January	1,390	1,050	1,220	75,000
February	1,050	824	929	51,600
March	8,760	920	1,760	108,000
April	20,200	6,700	11,700	696,000
May	6,780	2,830	4,780	294,000
June	2,780	1,620	2,190	130,000
July	1,520	824	1,180	72,600
August	824	473	597	36,700
September	897	395	562	33,300
The year	20,200	395	2,710	1,960,000

MUSTINKA RIVER ABOVE WHEATON, MINN.

LOCATION.—On line between secs. 7 and 8, T. 127 N., R. 46 W., 1 mile upstream from Chicago, Milwaukee & St. Paul Railway crossing, 1½ miles northeast of Wheaton, Traverse County, and 8 miles above Lake Traverse, into which the river discharges.

DRAINAGE AREA.—About 900 square miles.

RECORDS AVAILABLE.—March 23 to September 30, 1917, when station was discontinued. June 7 to November 30, 1916, at point about 3½ miles farther downstream.

GAGE.—Chain gage attached to bridge; read by Henry Heggen.

DISCHARGE MEASUREMENTS.—Made from Chicago, Milwaukee & St. Paul Railway bridge 1 mile downstream from gage, or from highway bridge just below railway bridge.

CHANNEL AND CONTROL.—Bed composed of clay and silt. Control not well defined. Slope of river from station to Lake Traverse is so slight that the stage-discharge relation may possibly be affected by changes in the stage of the lake.

EXTREMES OF DISCHARGE.—Maximum stage during period, 14.7 feet at 6 p. m. April 1 (discharge, about 2,340 second-feet); minimum stage, 1.16 feet August 30, September 1, 4, and 5 (discharge, about 1 second-foot).

ACCURACY.—Stage-discharge relation probably permanent. Rating curve fairly well defined below 2,500 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records fair.

Discharge measurements of Mustinka River above Wheaton, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 14[a]	S. B. Soulé	2.24	31	Apr. 1	S. B. Soulé	14.61	2,160
14[a]	.....do	2.22	32	12	R. B. Kilgore	6.08	398
Mar. 31	R. B. Kilgore	14.16	1,780	12	.....do	6.38	444
31	.....do	14.24	1,860	Sept. 21	.....do	1.33	1.1
Apr. 1	S. B. Soulé	14.64	2,300	21	.....do	1.33	1.1

[a] Measurement made at site of old gaging station "Mustinka near Wheaton" about 3½ miles downstream from present gage.

Daily discharge, in second-feet, of Mustinka River above Wheaton, Minn., for the year ending Sept. 30, 1917.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	....	2,240	460	28	9	2	1
2	....	2,040	446	27	7	3	1
3	....	1,320	404	23	4	3	1
4	....	740	348	20	4	3	1
5	....	600	307	20	4	2	1
6	....	530	270	24	4	2	2
7	....	446	246	27	3	2	2
8	....	404	222	30	3	2	2
9	....	432	210	30	3	2	2
10	....	404	188	28	3	2	1
11	....	334	178	27	3	2	1
12	....	418	159	22	2	2	2
13	....	488	210	28	6	2	2
14	....	460	137	24	4	2	2
15	....	418	125	21	3	2	2
16	....	404	117	17	3	3	2
17	....	376	101	14	3	2	2
18	....	376	93	11	3	2	2
19	....	390	82	9	3	2	3
20	....	488	79	8	2	2	2
21	....	768	76	7	2	1	2
22	....	768	71	8	2	1	2
23	89	614	68	9	2	1	2
24	125	530	58	10	2	1	2
25	294	516	52	11	2	1	3
26	446	530	48	10	2	2	3
27	586	474	44	10	2	2	3
28	866	418	40	10	1	1	3
29	964	404	36	8	1	1	3
30	1,550	446	32	9	2	1	3
31	1,840	....	28	....	3	1	....

Monthly discharge of Mustinka River above Wheaton, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 909 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
March 29-31	1,840	89	751	0.884	0.28
April	2,240	334	626	.696	.78
May	460	28	159	.177	.20
June	30	7	17.7	.020	.02
July	9	1	3.13	.0035	.004
August	3	1	1.84	.0020	.002
September	3	1	2.00	.0022	.002

WILD RICE RIVER AT TWIN VALLEY, MINN.

LOCATION.—In SW. ¼ sec. 22, T. 144 N., R. 44 W., at highway bridge at Twin Valley, Norman County, 2 miles above a small tributary which enters from the right at Heiberg.

DRAINAGE AREA.—805 square miles.

RECORDS AVAILABLE.—June 30, 1909, to September 30, 1917, when station was discontinued.

GAGE.—Vertical staff gage attached to pier of bridge, at left bank; read by Axel Johnson.

DISCHARGE MEASUREMENTS.—Made from the bridge by wading.

CHANNEL AND CONTROL.—One channel at all stages; bed composed of sand and silt. Control not well defined. Right bank high and wooded; left bank will be overflowed to some extent at stage of 12 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded, 7.2 feet April 3 (discharge, about 622 second-feet); minimum stage recorded, 4.48 feet, August 27 (discharge, 14 second-feet).

1909–1917: Maximum stage recorded, 20.0 feet at 7 a. m. July 22, 1909 (discharge, about 9,290 second feet); minimum open-water discharge 12 second-feet August 31 and September 1, 1913; minimum winter discharge measured by current meter, 10 second-feet February 5, 1913; the absolute minimum was probably less than this amount.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—Discharge affected by storage created by dams at the lower end of Lower Rice Lake, and at the outlet of Twin Lakes.

ACCURACY.—Stage-discharge relation not permanent; change occurred probably during spring when ice left the river. Rating curve used October 1 to April 1 well defined between 37 and 2,290 second-feet; curve used April 2 to September 30 well defined between 20 and 3,400 second-feet. Gage read to half-tenths twice daily, except November 21 to March 23, when it was read once weekly. Daily discharge ascertained by applying mean daily gage height to rating table, except during period when stage-discharge was affected by ice, for which it was obtained by applying to rating table a weekly gage height corrected for effect of ice by means of discharge measurements, observer's notes and weather records. Open-water records good; winter records fair.

Discharge measurements of Wild Rice River at Twin Valley, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 16	L. B. Dale	5.42	162	Aug. 1	E. F. Chandler	4.66	30
Jan. 2[a]	T. M. Wardwell	5.70	55	1	do	4.66	32
Feb. 11[a]	do	5.10	44	1	do	4.66	31
Mar. 17[a]	do	5.80	48	2	do	4.60	21
Apr. 2[a]	do	7.25	647	2	do	4.60	24

[a] Ice on control.

Daily discharge, in second-feet, of Wild Rice River near Twin Valley, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	157	143					530	344	139	62	29	90
2	147	136					560	358	128	55	25	90
3	147	128					622	331	101	55	24	90
4	157	128					530	318	101	59	26	85
5	157	128	100	70		40	560	305	93	49	26	85
6	157	128					560	280	114	48	29	85
7	163	128					591	280	69	48	29	80
8	167	138					500	280	69	69	29	77
9	167	138					471	266	74	59	25	77
10	167	147					442	244	80	55	26	77
11	157	119					442	233	85	55	26	77
12	157	94					385	221	83	55	19	69
13	147	87					358	210	83	48	19	55
14	157	94					331	199	85	54	19	31
15	147	138	85	65	40	45	331	199	80	48	19	26
16	157	119					331	199	77	49	15	28
17	147	110					331	199	62	48	19	29
18	147	110					331	188	85	48	24	19
19	147	102					358	188	90	45	17	29
20	143	102					385	163	85	45	19	29
21	128					50	399	147	80	41	19	26
22	128					60	385	137	74	48	19	26
23	128					70	358	124	65	45	19	26
24	147					110	358	143	77	35	19	29
25	147	90	55	45		210	358	165	69	35	19	29
26	138					331	344	167	69	35	14	29
27	138					188	344	167	69	35	14	33
28	138					280	344	167	65	35	14	33
29	138				......	358	344	151	65	33	77	33
30	138				......	413	344	143	62	29	77	33
31	138	......			......	530	......	137	......	29	80	......

Note.—Stage-discharge relation affected by ice Nov. 14 to Apr. 1. Braced figures show mean discharge for period indicated.

Monthly discharge, in second-feet, of Wild Rice River at Twin Valley, Minn., for the year ending Sept. 30, 1917.

Month.	Maximum.	Minimum.	Mean.
October	167	128	148
November	147		111
December			79.2
January			59.5
February			40.0
March	530		111
April	622	331	418
May	358	124	214
June	139	62	82.6
July	69	29	46.9
August	80	14	26.9
September	90	19	50.8
The year	622	14	116

DEVILS LAKE NEAR DEVILS LAKE, N. DAK.

LOCATION.—At biologic station of University of North Dakota, near Devils Lake, in Ramsey County, 6 miles southwest of city of Devils Lake.

DRAINAGE AREA.—The theoretical drainage area of the lake is about 3,700 square miles. In years of ordinary rainfall water reaches the lake from only a small part of this area, most of which drains into local depressions and small lakelets, where the water remains until it is lost by evaporation. In 1880 the length of Devils Lake was 35 miles and its area about 120 square miles, but its present area is probably less than 60 square miles.

RECORDS AVAILABLE.—June 8, 1901, to September 30, 1917 (fragmentary).

GAGE.—Staff gage on pier at the biologic station. Zero of gage, 1,393.3 feet above sea level. Previous to 1916 staff gages were placed at convenient points on piers, but it has been necessary to renew them occasionally, sometimes every year, owing to damage caused by ice during the spring break-up. These gages have been reset as near to the correct datum as possible, often by the use of a carpenter's level. Occasionally errors of 0.1 foot in the records have been discovered when accurate checks were made, but no larger errors are likely to occur. The gage is read occasionally by employees of the biologic station.

REGULATION.—The lake has no outlet. The stage of the lake shows the relation between evaporation from the lake surface and the inflow from the surrounding country and gives an indication whether the run-off has been affected by the settlement of the drainage area and cultivation of the land surface.

COOPERATION.—Records are furnished by the North Dakota Biological Survey.

Gage height of Devils Lake near Devils Lake, N. Dak., during the year ending Sept. 30, 1917.

Date.	Gage height.	Date.	Gage height.	Date.	Gage height.
	Feet.		*Feet.*		*Feet.*
Sept. 26	7.12	Aug. 6	6.22	Sept. 10	5.77
Nov. 5	(a)	9	6.19		
Apr. 15	7.07	30	5.91		

a About 6.9 feet.

RED LAKE RIVER AT THIEF RIVER FALLS, MINN.

LOCATION.—In sec. 33, T. 154 N., R. 43 W., one-third mile below dam at Thief River Falls, Pennington County, and 1 mile below mouth of Thief River, which comes in from the right.

DRAINAGE AREA.—3,430 square miles.

RECORDS AVAILABLE.—July 2, 1909, to September 30, 1917.

GAGE.—Inclined staff gage located on right bank; read by Dedrick Knutson.

DISCHARGE MEASUREMENTS.—Made from cable near gage.

CHANNEL AND CONTROL.—Gravel; practically permanent.

EXTREMES OF DISCHARGE.—Maximum open-water stage recorded, 10.6 feet April 10 (discharge, 5,060 second-feet); minimum open-water stage recorded, 3.61 feet August 26 (discharge, 99 second-feet); minimum discharge estimated at 97 second-feet December 11, when river was frozen over.

1909–1917: Maximum open-water stage recorded, 12.2 feet, April 19–21, 1916 (discharge, 7,040 second-feet); minimum discharge recorded, zero, July 17 and August 27, 1911.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—A short distance above the station is a dam owned by the Hansen & Barzen Milling Co. and the city lighting plant. The variation in load on the turbines, due to the operation of the lighting plant (at night) and of the mill (chiefly during the day), caused fluctuations in the river at the gage.

ACCURACY.—Stage-discharge relation fairly permanent. Rating curve well developed between 19 and 5,600 second-feet. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except for period when stage-discharge relation was affected by ice, for which it was obtained by applying to rating table daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good except on certain days when diurnal fluctuation was such that one reading would not give mean for day; winter records fair.

Discharge measurements of Red Lake River at Thief River Falls, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 31[a]	T. M. Wardwell	6.35	346	Apr. 1	T. M. Wardwell	6.11	889
Feb. 11[a]	L. B. Dale	5.89	410	5	....do	6.84	1,660
Mar. 18[a]	....do	5.98	446	June 19	E. F. Chandler	5.21	610
Apr. 1	T. M. Wardwell	6.25	875	Sept. 6	....do	4.22	293

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Red Lake River at Thief River Falls, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,300	1,170	515	393	357	472	890	1,430	790	582	412	159
2	1,300	1,300	538	431	290	472	940	1,360	790	605	306	258
3	1,110	1,300	538	323	357	472	995	1,300	765	538	274	258
4	1,050	1,300	605	323	357	472	1,360	1,300	765	515	274	133
5	1,050	1,300	538	290	323	472	1,720	1,230	765	560	186	186
6	1,050	1,300	538	258	323	560	2,110	1,300	765	538	274	159
7	1,050	1,170	515	258	290	605	1,960	1,230	790	515	242	133
8	1,050	1,300	472	290	323	605	3,700	1,300	765	452	186	258
9	995	1,230	605	290	323	560	4,000	1,230	740	472	274	186
10	995	1,170	605	323	357	605	5,060	1,110	718	494	266	212
11	940	605	97	323	323	605	4,500	1,110	695	515	258	290
12	840	290	560	290	393	605	4,610	1,050	718	452	186	323
13	790	515	605	323	431	605	4,610	1,050	628	452	274	258
14	1,050	560	650	290	431	605	4,200	995	538	340	242	186
15	940	640	650	290	472	650	3,600	995	515	452	242	212
16	940	718	560	258	393	740	2,820	970	560	472	186	227
17	1,500	790	650	258	323	650	2,460	940	628	472	186	242
18	1,570	695	740	258	393	393	2,280	840	605	340	212	258
19	840	695	740	290	431	472	2,280	840	650	357	212	212
20	890	650	740	290	431	740	2,280	940	560	472	212	242
21	940	840	740	258	431	890	2,110	995	560	412	186	274
22	890	605	472	290	431	695	1,870	940	582	412	242	242
23	940	605	393	393	393	840	1,720	940	605	375	186	212
24	840	431	375	323	431	840	1,570	890	560	357	186	186
25	940	452	357	258	472	740	1,640	890	605	375	142	242
26	995	452	382	258	472	695	1,570	890	605	357	99	186
27	1,050	452	406	258	472	650	1,640	865	560	340	133	212
28	1,050	452	431	258	472	790	1,640	840	560	323	186	186
29	1,050	452	418	323	....	740	1,500	840	605	323	133	199
30	1,110	494	406	323	....	890	1,430	840	593	290	212	212
31	1,170	....	393	323	....	940	....	790	....	357	306	....

NOTE.—Stage-discharge relation affected by ice Nov. 13 to Apr. 5. Gage not read, discharge interpolated Oct. 20, Apr. 19, May 16, 27, June 13, 22, 30, Aug. 10, 25, Sept. 16 and 29.

Monthly discharge, in second-feet, of Red Lake River at Thief River Falls, Minn., for the year ending Sept. 30, 1917.

Month.	Maximum.	Minimum.	Mean.
October	1,570	790	1,040
November	1,300	290	798
December	740	97	524
January	431	258	300
February	472	290	389
March	940	393	647
April	5,060	890	2,440
May	1,430	790	1,040
June	790	515	653
July	605	290	436
August	412	99	223
September	290	133	218
The year	5,060	97	725

RED LAKE RIVER AT CROOKSTON, MINN.

LOCATION.—In sec. 31, T. 150 N., R. 46 W., at new Sampson's Addition highway bridge in Crookston, Polk County, a quarter of a mile below dam and power house of Crookston Waterworks Power & Light Co.'s plant. No tributaries enter for several miles.

DRAINAGE AREA.—5,320 square miles.

RECORDS AVAILABLE.—May 19, 1901, to September 30, 1917.

GAGE.—Barret & Lawrence water-stage recorder on right abutment of bridge; installed in September, 1911; replaced chain gage attached to bridge July 1, 1909; both gages at same datum. Prior to July 1, 1909, gage was on old Sampson's Addition bridge, about 300 feet farther upstream; this gage read the same as the present one at ordinary stages. Gage inspected by Roy Lundahl.

DISCHARGE MEASUREMENTS.—Made from steel highway bridge at gage section.

CHANNEL AND CONTROL.—Control not well defined; one channel at all stages; slightly shifting.

EXTREMES OF DISCHARGE.—Maximum mean daily stage during year, from water-stage recorder, 11.9 feet April 11 (discharge, estimated because of ice at control, about 5,320 second-feet); minimum mean daily stage, from water-stage recorder, 2.39 feet August 30 (discharge, 78 second-feet).

1901–1917: Maximum mean daily stage recorded, 21.5 feet April 17, 1916 (discharge, 14,400 second-feet). A minimum discharge of 10 second-feet was recorded by discharge measurement made January 27, 1912. The flow is controlled to such an extent that the minimum recorded discharge has no bearing on the minimum natural flow.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—Considerable diurnal fluctuation at the gage is caused by the operation of the power plant immediately above the station. The plant has little storage, so that the mean monthly flow should represent nearly the natural flow.

ACCURACY.—Stage-discharge relation fairly permanent throughout the year. Rating curve used well developed between 100 and 10,000 second-feet. Operation of water-stage recorder satisfactory throughout year except during extremely cold weather when records are fragmentary; during such periods readings from chain gage were taken. Daily discharge obtained by applying to rating table mean daily gage height obtained by planimeter from the gage-height graph except for winter period for which it was obtained by applying to the rating table the mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records excellent; winter records subject to error.

Discharge measurements of Red Lake River at Crookston, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 9	E. F. Chandler	5.33	1,220	Mar. 17[a]	T. M. Wardwell	5.90	450
Dec. 28[a]	T. M. Wardwell	5.40	620	Apr. 2[a]	.....do	10.50	3,060
Jan. 6[a]	.....do	5.11	419	July 9	E. F. Chandler	4.07	647
Feb. 12[a]	.....do	5.40	377	Aug. 2	.....do	3.22	304

[a] Ice at control.

Daily discharge, in second-feet, of Red Lake River at Crookston, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,380	1,260	540	570	421	540	2,900	1,880	1,050	740	324	95
2	1,380	1,260	620	560	421	540	2,830	1,820	1,050	740	303	104
3	1,380	1,320	700	550	620	540	2,760	1,760	1,000	740	278	119
4	1,320	1,380	700	540	415	540	2,620	1,880	1,000	740	296	126
5	1,260	1,440	820	421	210	540	2,900	1,880	1,000	740	314	130
6	1,260	1,440	820	421	335	500	3,750	1,820	1,000	700	328	140
7	1,260	1,260	820	540	460	460	4,070	1,820	955	700	324	144
8	1,150	1,260	820	660	310	421	4,800	1,820	955	700	317	142
9	1,150	1,260	865	780	350	421	4,720	1,690	955	700	310	136
10	1,200	1,200	865	560	383	421	4,980	1,560	955	700	310	132
11	1,050	1,100	660	346	400	480	5,320	1,560	910	700	306	119
12	1,000	910	670	310	421	540	4,310	1,500	910	700	296	112
13	955	700	670	275	460	620	4,310	1,500	910	700	296	100
14	910	460	680	290	430	780	4,390	1,440	910	700	300	100
15	865	328	680	310	310	700	4,390	1,380	910	700	303	104
16	955	410	680	330	383	580	4,070	1,320	910	700	310	119
17	1,000	490	690	346	420	460	3,910	1,320	865	740	321	132
18	955	575	690	346	460	580	3,670	1,320	820	740	328	144
19	955	660	700	260	500	700	3,200	1,320	780	700	317	156
20	955	740	660	180	480	660	3,120	1,260	780	700	324	177
21	910	820	421	250	460	740	2,980	1,260	780	660	346	186
22	910	740	383	310	420	740	2,830	1,200	780	620	346	195
23	955	740	152	383	383	740	2,690	1,200	780	600	332	213
24	1,000	660	250	152	421	820	2,550	1,200	780	580	272	236
25	955	660	340	242	500	780	2,480	1,200	780	560	223	239
26	1,000	620	430	242	580	1,000	2,340	1,200	780	540	183	239
27	955	540	520	275	560	1,050	2,280	1,150	780	500	163	239
28	1,050	620	620	330	540	1,100	2,280	1,100	780	460	142	239
29	1,150	660	610	383	....	1,200	2,280	1,100	780	421	112	239
30	1,200	620	600	400	....	1,500	2,280	1,060	740	387	78	239
31	1,260	....	590	421	....	2,140	....	1,050	....	353	84	....

NOTE.—Stage-discharge relation affected by ice Nov. 14 to Apr. 16. Gage not in operation Oct. 1; discharge estimated.

Monthly discharge, in second-feet, of Red Lake River at Crookston, Minn., for the year ending Sept. 30, 1917.

Month.	Maximum.	Minimum.	Mean.
October	1,380	865	1,090
November	1,440	328	871
December	865	152	621
January	780	152	387
February	620	210	430
March	2,140	421	737
April	5,320	2,280	3,400
May	1,880	1,050	1,440
June	1,050	740	889
July	740	353	644
August	346	78	274
September	239	95	160
The year	5,320	78	[illegible]

THIEF RIVER NEAR THIEF RIVER FALLS, MINN.

LOCATION.—In sec. 3, T. 154 N., R. 43 W., at Drybrook ford, Pennington County, 5 miles north of Thief River Falls. Nearest tributary, outlet of Mud Lake, which enters in northeastern part of T. 156 N., R. 42 W.

DRAINAGE AREA.—1,010 square miles.

RECORDS AVAILABLE.—July 1, 1909, to September 30, 1917, when station was discontinued.

GAGE.—Chain gage installed August 26, 1915, on cantilever timber fastened to a tree on right bank. Inclined staff gage, installed September 4, 1913, to replace old inclined staff gage, which was set at incorrect gage datum, was used until August 26, 1915. Gage read by T. H. Risteigen.

DISCHARGE MEASUREMENTS.—Made from steel highway bridge 1,000 feet below the gage; at low stages made by wading near the gage.

CHANNEL AND CONTROL.—Heavy gravel and boulders; nearly permanent; one channel at all stages. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 12.6 feet April 11 (discharge, 2,550 second-feet); minimum stage 3.63 feet August 25 (discharge 0.5 second-foot).

1909–1917: Maximum stage recorded, 14.5 feet, April 23, 1916 (discharge, 4,080 second-feet); no flow in October, November, and December, 1910, January, February, and December, 1911, January and February, 1912, and February, 1916.

REGULATION.—Dam at Thief River Falls at the mouth of Thief River, backs up the water in Thief River for several miles, but station is protected from influence of dam by rapids below.

ACCURACY.—Stage-discharge relation nearly permanent. Rating curve well defined between 0.1 second-feet and 3,800 second-feet. Gage read to hundredths twice a day. Daily discharge ascertained by applying mean daily gage heights to rating table, except during period when stage-discharge relation was affected by ice, for which period it was obtained by applying to rating table occasional gage height corrected for ice effect by means of discharge measurements, observer's notes and weather records. Open-water records excellent except those for discharge below 10 second-feet which are subject to error; winter records subject to error.

Discharge measurements of Thief River near Thief River Falls, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 20	T. M. Wardwell	4.68	1.5	Apr. 6	T. M. Wardwell	9.77	845.
Feb. 10	L. B. Dale	3.54	1.4	June 19	E. F. Chandler	4.61	32.
Mar. 17	.....do	4.05	0.7	Sept. 6	.....do	3.81	1.6

Daily discharge, in second-feet, of Thief River near Thief River Falls, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	244	185	26				32	322	37	29	5	0.7
2	244	187	26				32	295	37	29	4	0.9
3	232	182	26				35	282	37	27	4	1
4	232	182	26				32	256	36	27	4	2
5	220	182	25				126	244	36	32	4	2
6	208	182	25				440	231	35	37	4	2
7	208	182	25				1,370	219	35	40	4	2
8	196	178	25				1,210	219	35	38	4	1
9	191	178	20				1,410	207	34	34	4	1
10	169	173	20				2,020	183	34	31	4	2
11	208	155	14				2,550	150	35	26	4	2
12	155	151	14				1,970	109	42	22	3	1
13	134	130	10			2	1,740	86	51	21	2	1
14	134	126	10				1,660	77	52	21	2	1
15	130	116	10		3		1,370	72	49	20	1	1
16	122	106	10	5			1,020	66	47	18	.8	2
17	116	97	13				920	65	41	14	.7	2
18	108	87	16				850	65	36	12	.6	2
19	86	79	16				780	65	28	10	.6	2
20	86	68	4				710	63	15	10	.6	3
21	90	61					675	62	19	9	.6	4
22	99	50					572	58	20	9	.6	5
23	108	43					538	54	21	9	.6	6
24	112	38					472	51	20	9	.6	7
25	126	31					456	48	21	9	.5	8
26	140	23	3			3	440	46	23	8	.6	9
27	112	23				6	409	44	24	8	.6	9
28	134	23				10	379	40	25	8	.6	9
29	166	25			....	14	364	39	29	8	.6	9
30	180	26			....	25	350	30	30	7	.6	9
31	182	....			....	25	....	37	....	7	.7	....

NOTE.—Stage-discharge relation affected by ice Nov. 11 to Apr. 13. Gage not read Sept. 16–19, 21–25, 27–30, discharge estimated. Braced figures show mean discharge for period included.

Monthly discharge, in second-feet, of Thief River near Thief River Falls, Minn., for the year ending Sept. 30, 1917.

Month.	Maximum.	Minimum.	Mean.
October	308	86	160
November	187	23	109
December	26	3	12.7
January	....	....	5.0
February	....	....	3.0
March	....	....	4.29
April	2,550	32	831
May	322	37	122
June	52	15	32.8
July	40	7	19.0
August	6	.5	2.03
September	9	.7	3.55
The year	2,550	.5	108

CLEARWATER RIVER AT RED LAKE FALLS, MINN.

LOCATION.—In sec. 22 T. 151 N., R. 44 W., at Great Northern Railway bridge at Red Lake Falls, Red Lake County, about 1½ miles above mouth and 2 miles below nearest tributary, a stream coming in from the left.

DRAINAGE AREA.—1,310 square miles.

RECORDS AVAILABLE.—June 18, 1909, to September 30, 1917, when station was discontinued.

GAGE.—Combination vertical and inclined staff gage, installed September 12, 1911, about half a mile downstream from original gage, as the building of a dam caused several feet of backwater at the old section. New gage set to read 2.23 feet when the original gage read 5.83 feet. Gage read by Leo Steinert.

DISCHARGE MEASUREMENTS.—Made from Great Northern Railway bridge or by wading about 300 feet below gage.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; smooth. Control nearly permanent. Two channels at low stages, united at high stages. Banks high, wooded and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.4 feet April 11 (discharge, 1,080 second-feet); minimum stage recorded, 1.84 feet, August 21 (discharge 42 second-feet).

1909–1917: Maximum discharge recorded 3,990 second-feet, April 15 and 16, 1916; minimum discharge 20 second-feet, July 4, 1911.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—At low stages flow is affected by the Steinert dam, 600 feet above the gage. The storage at this plant is small and only a slight diurnal fluctuation is observable at gage.

ACCURACY.—Stage-discharge relation fairly permanent. Rating curve well defined between 53 and 1,160 second-feet and fairly well defined between 1,160 and 3,550 second-feet. Gage read to tenths twice a day. Daily discharge ascertained by applying mean daily gage height to rating curve, except during period when stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table daily or weekly gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good except those for extreme low stages which are fair; winter records subject to error.

Discharge measurements of Clearwater River at Red Lake Falls, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 30[a]	T. M. Wardwell	3.42	82	Aug. 3	E. F. Chandler	2.27	85
Feb. 12[a]	L. B. Dale	4.60	70	3	.....do	2.15	66
Mar. 16[a]	.....do	4.55	65	Sept. 17	.....do	2.22	82
Apr. 4[a]	T. M. Wardwell	6.15	450	17	.....do	2.12	63
Aug. 3	E. F. Chandler	2.21	68				

a Ice at control.

Daily discharge, in second-feet, of Clearwater River at Red Lake Falls, Minn., for the year ending Sept. 30, 1917.

Day.	Oct	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	101	120						476	116	62	84	51
2	120	120						376	116	62	72	55
3	120	101						376	116	62	72	62
4	120	101						291	116	62	67	55
5	110	101	40				740	291	99	72	62	55
6	101	85						270	99	67	62	62
7	101	85						251	99	72	62	67
8	85	78						251	91	77	62	72
9	78	72						251	84	91	62	72
10	72	72						219	84	84	72	72
11	72	72					1,080	219	84	72	72	62
12	78						1,000	219	91	84	72	67
13	85					65	968	219	99	84	72	62
14	85						895	219	91	72	72	62
15	85				70		700	251	84	72	72	62
16	93	46	60	70			556	251	72	67	67	67
17	101						529	251	72	62	67	77
18	101						529	219	84	62	48	84
19	101						476	173	84	55	48	84
20	101						476	138	84	55	45	84
21	120						450	138	84	55	42	84
22	120						425	138	72	55	42	77
23	142						425	116	72	55	48	72
24	142						425	116	72	48	45	72
25	142						425	116	72	48	42	77
26	142	45	70				425	116	67	51	42	84
27	131						400	127	62	55	42	84
28	120						376	138	67	62	48	84
29	101				......	290	376	138	72	72	45	72
30	110				......		425	138	67	84	42	62
31	120				......		......	127	......	84	48	......

NOTE.—Stage-discharge relation affected by ice Nov. 12 to Apr. 10. Braced figures show mean discharge for period included.

Monthly discharge, in second-feet, of Clearwater River, at Red Lake Falls, Minn., for the year ending Sept. 30, 1917.

Month.	Maximum.	Minimum.	Mean.
October	142	72	106
November	120		63.9
December			57.1
January			70.0
February			70.0
March			109
April		376	625
May	476	116	214
June	116	62	85.7
July	91	48	66.6
August	84	42	58.0
September	84	51	70.0
The year			133

ROSEAU RIVER AT CARIBOU, MINN.

LOCATION.—In sec. 34, T. 164 N., R. 45 W., at steel highway bridge in Caribou, Kittson County, 1 mile south of international boundary and 3 miles upstream from crossing of boundary line by river.

DRAINAGE AREA.—1,340 square miles.

RECORDS AVAILABLE.—April 1 to October 6, 1917, when station was discontinued.

GAGE.—Chain gage fastened to downstream handrail of bridge, 60 feet from left abutment; read by James A. McKibbin.

DISCHARGE MEASUREMENTS.—Made from highway bridge.

CHANNEL AND CONTROL.—Channel is artificial, of trapezoidal cross-section, about 100 feet wide and 10 feet deep. Bed composed of hardpan, with few scattered large boulders. Stage of zero flow, bottom of channel, gage height about 3.0 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 9.4 feet April 17 and 18 (discharge, 1,370 second-feet); minimum stage, 3.15 feet September 29 (discharge, about 4 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

DIVERSIONS.—No diversions involving storage or loss of water. A channel about 3½ miles long was dredged some years ago from a point about 4 miles above the station to a point 1 mile below. At a stage of about 6.0 feet water flows in this channel and must be measured and included in all measurements of main channel.

REGULATION.—None.

ACCURACY.—Stage-discharge relation probably permanent. Rating curve, based on two discharge measurements and by use of Kutter formula, only fairly well defined between 5 and 1,200 second-feet. Daily discharge ascertained by applying mean daily gage height to rating table, except during period when stage-discharge relation was affected by ice, for which it was obtained by applying to rating table mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Records fair.

Discharge measurements of Roseau River at Caribou, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 9[a]	T. M. Wardwell	7.30	336	Apr. 28	T. M. Wardwell	7.96	879
10[a]	....do	7.97	396	Sept. 5	E. F. Chandler	3.30	9

[a] Ice at control.

Daily discharge, in second-feet, of Roseau River at Caribou, Minn., for the period Apr. 1 to Oct. 6, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	113	1,090	20	88	27	24	6
2	126	1,160	176	94	24	27	7
3	154	805	94	100	24	35	9
4	184	776	76	88	24	35	12
5	216	776	65	88	24	27	14
6	233	720	65	100	24	17	17
7	250	720	49	82	20	6	
8	250	666	44	76	20	6	
9	324	666	39	76	17	6	
10	405	614	35	72	17	4	
11	448	589	31	72	17	4	
12	564	564	40	65	20	4	
13	516	516	49	60	20	6	
14	666	516	44	60	24	6	
15	1,090	470	54	54	24	6	
16	1,200	448	72	54	24	7	
17	1,370	426	88	54	27	9	
18	1,370	384	82	49	27	9	
19	1,260	344	76	44	20	14	
20	1,200	324	65	44	12	60	
21	1,120	305	54	40	6	65	
22	1,060	259	54	40	9	54	
23	1,020	233	49	35	7	37	
24	988	200	49	31	6	24	
25	956	176	44	27	6	12	
26	925	162	44	27	6	7	
27	894	147	49	27	6	6	
28	894	100	65	31	6	6	
29	864	54	54	31	9	4	
30	925	27	88	27	14	4	
31		9		27	20		

NOTE.—Stage-discharge relation affected by ice Apr. 1-14.

Monthly discharge, in second-feet, of Roseau River at Caribou, Minn., for the year ending Sept. 30, 1917.

Month.	Maximum.	Minimum.	Mean.
April	1,370	113	720
May	1,160	9	460
June	176	20	60.5
July	100	27	56.9
August	27	6	17.1
September	65	4	17.7

MOUSE RIVER AT MINOT, N. DAK.

LOCATION.—At Anne Street footbridge, northeast of Great Northern Railway roundhouse at Minot.

DRAINAGE AREA.—8,400 square miles.

RECORDS AVAILABLE.—May 5, 1903, to September 30, 1917.

GAGE.—Vertical staff attached to Anne Street footbridge on pier nearest left bank; vertical staff for low-stage readings on same bridge on pier nearest right bank. From 1903 to December, 1909, gage was a vertical staff similarly placed on a footbridge then existing about 20 rods above Anne Street. All gages at same datum. Gage read by Ephraim Cox.

DISCHARGE MEASUREMENTS.—Made from Anne Street bridge or by wading a few rods below the dam at the Soo Railway water tank.

CHANNEL AND CONTROL.—Bed composed of clay and silt; nearly permanent. Capacity of channel at high stages changed slightly by artificial structures or encroachments through the city. Control is a 5-foot dam of timbers and loose rock a mile below the gage, at the Soo Railway water tank; the dam raises the water at the gage about 3 feet at ordinary low stage, when the water just reaches the crest of the dam. Some water leaks through the dam, and when the discharge of the river is less than about 8 second-feet the water level falls below the crest.

Extremes of discharge.—Maximum stage during the year, 11.4 feet April 29 (discharge, 1,280 second-feet); minimum stage, 3.0 feet September 28 (discharge, 0.3 second-foot).

1903–1917: Maximum stage recorded, 21.9 feet April 20, 1904 (discharge, 12,000 second-feet); minimum stage, 1.8 feet February 28, 1913 (discharge, 0.1 second-foot).

Ice.—Stage-discharge relation only slightly affected by ice.

Diversions and regulation.—None above station, so far as known.

Accuracy.—Stage-discharge relation not permanent; slightly affected by changes in control and by ice. Rating curve used October 1 to February 28 fairly well defined; curve used March 1 to September 30 fairly well defined above 30 second-feet. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good, except for extreme low stages, which are fair.

Discharge measurements of Mouse River at Minot, N. Dak., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Dec. 28	L. B. Dale	4.39	7.
Apr. 21	E. F. Chandler	9.06	901
July 16	.....do	4.66	30.

Daily discharge, in second-feet, of Mouse River at Minot, N. Dak., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	23	23					548	1,250	253	113	21	0.
2	23	23	29				500	1,230	240	104	21	
3	26	23			5	9	476	1,220	240	104	18	
4	29	23					476	1,210	227	96	18	
5	29	26					452	1,150	227	96	18	
6	29	26		12			500	1,120	240	96	16	
7	26	26					548	1,120	240	88	16	
8	23	29					596	1,140	227	88	18	
9	23	29	29				762	1,160	227	88	21	
10	26	33			3	24	886	1,190	227	74	21	
11	29	33					1,010	1,220	214	74	21	
12	29						1,050	1,210	214	61	24	
13	26			10			1,050	1,180	201	74	24	
14	23						1,080	1,080	214	74	24	
15	23						1,110	950	253	88	21	
16	23		23				1,140	816	214	74	16	
17	23				5	9	1,120	762	176	74	11	
18	26	42				10	1,080	722	188	66	11	
19	26					10	1,040	682	176	56	11	
20	26			17		10	966	640	188	45	11	
21	26					20	934	476	188	40	9	
22	23					40	918	452	176	36	8	
23	23		17			80	934	400	164	31	8	
24	23				8	142	966	400	153	31	4	
25	26	29				140	1,070	374	153	36	1.8	
26	26					140	1,150	320	142	36	1.6	
27	26			12		150	1,220	292	142	31	1.3	
28	26					200	1,250	279	132	28	1.2	
29	26					250	1,280	266	122	28	1.0	
30	26		12			300	1,260	266	113	24	0.9	
31	23					548		253		24	0.8	

Monthly discharge of Mouse River at Minot, N. Dak., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	29	23	25.3	1,560
November			31.6	1,880
December			22.2	1,360
January			12.5	768
February			5.4	299
March			74.1	4,560
April	1,280	452	912	54,300
May	1,250	253	801	49,200
June	253	113	196	11,600
July	113	24	63.8	3,920
August	24	.8	12.9	793
September	.8	.3	.5	30
The year	1,280	.3	180	130,000

EVAPORATION AT UNIVERSITY, N. DAK.[1]

The evaporation gage at University, N. Dak., was established April 17, 1905, on a pool in a ravine called English Coulee, which runs through the campus of the University of North Dakota, immediately west of Grand Forks, N. Dak., and 2 miles west of the Minnesota boundary.

The coulee drains about 60 square miles of very level prairie. Except for brief freshets the flow in the coulee is small, varying from 1 second-foot or less to 20 second-feet. In very dry weather the water lies in pools with scarcely any perceptible flow.

A heavy galvanized-iron tank, 3 feet square and 18 inches deep, is placed in the center of an anchored raft, so that the water in the tank is at the same level as the water surface outside. The tank is filled nearly to the top, to a height precisely marked by the pointed tip of a vertical rod in the center of the tank. Once each day, after the change produced by evaporation or rainfall, the water level is restored to the original height, the precise amount of water transferred being measured with a cup of such size that one cupful of water is equivalent to 0.01 inch depth in the tank.

On the open prairie about 40 rods distant is a standard rain gage. On days of rainfall the difference (which is usually small) between the quantity measured by the rain gage and the surplus in the tank is considered the total evaporation for the day.

Observations were made usually about half an hour before sunset. The temperature of the water recorded is the observation of the water in the tank. As the tank is made of metal, it has been found that at that time of the day there is rarely a perceptible difference in temperature reading between the water within and without the tank. The temperature of the air as recorded is the mean of the readings of the standard self-recording maximum and the self-recording minimum thermometers for the preceding 24 hours.

[1] For complete description of this station and records of evaporation, rainfall, and temperature for 1905 to 1908 see U. S. Geol. Survey Water-Supply Paper 245, pp. 64-67, 1910.

The following table shows for each 10-day period during the years ending September 30, 1916 and 1917, the gross evaporation, the total rainfall, and the mean temperatures for the 10 observations of the water and of the air.

Evaporation observations at University, N. Dak., for years ending Sept. 30, 1916 and 1917.

Date.	Evaporation.	Rainfall.	Mean temperature (°F.).		Date.	Evaporation.	Rainfall.	Mean temperature (°F.).	
			Water.	Air.				Water.	Air.
1915-1916.	*Inches.*	*Inches.*			1916-1917.	*Inches.*	*Inches.*		
Oct. 1-10	0.84	0.08	41	42	Oct. 1-10	0.79	0.06	51	43
11-20	.86	.09	46	48	11-20	.40	.31	39	36
21-31	1.24	.11	45	46	21-31	.44	.27	36	35
Nov. 1-10	.77	.64	37	38	Nov. 1-9	.50	.00	37	41
May 17-20	.65	.00	50	47	Apr. 25-30	.34	.61	45	39
20-31	1.27	.72	59	56	May 1-10	1.07	.23	56	48
June 1-10	1.70	.52	62	56	11-20	2.21	.00	66	58
11-20	1.37	.84	64	57	21-31	1.75	.00	62	49
21-30	1.30	2.17	67	62	June 1-10	1.61	.17	54	56
July 1-10	1.37	1.66	78	74	11-20	1.67	1.20	58	59
11-20	1.90	1.48	80	74	21-30	1.99	.58	62	62
21-31	2.15	.37	77	73	July 1-10	1.35	2.68	77	64
Aug. 1-10	2.41	1.07	75	70	11-20	1.52	.08	76	67
11-20	1.68	.59	73	66	21-31	2.07	.08	85	75
21-31	1.86	1.91	67	60	Aug. 1-10	1.54	.29	64	61
Sept. 1-10	1.59	.57	......	63	11-20	1.73	1.20	63	69
11-20	1.17	.29	55	52	21-31	2.05	.09	68	63
21-30	1.00	.33	52	49	Sept. 1-10	1.38	.04	60	52
					11-20	.66	.79	60	60
					21-30	1.26	.05	57	55

RAINY LAKE AT RANIER, MINN.

Location.—In sec. 30, T. 71 N., R. 23 W., at foot of Rainy Lake at Ranier, Koochiching County.

Records available.—January 1, 1910, to September 30, 1917.

Gage.—Vertical staff gage at sawmill, about 500 feet above the Canadian Northern Railway bridge. Prior to June 6, 1916, a vertical staff gage in connection with a Haskell water-stage recorder on protecting crib above the Canadian Northern Railway bridge. For further information regarding location and datum of gages from which earlier records were obtained see Water-Supply Papers 325, 355, 385, and 405. Elevation of zero of gage used during present year is 488.00 feet, referred to what is known as the Minnesota and Ontario datum. The records have been reduced to a gage whose zero is at 489.00 feet, to correspond to records previously published.

Extremes of stage.—Maximum stage recorded during year, 8.56 feet October 1 and 2; minimum stage recorded, 1.9 feet September 26.

1910–1917: Maximum stage recorded, 10.99 feet June 10, 1916; minimum stage recorded, 0.85 foot March 22, 1911.

Regulation.—The stage of Rainy Lake is controlled at the dam and power plant of the Minnesota & Ontario Power Co., at International Falls, 2 miles below the outlet of the lake, water being stored during periods of high run-off and drawn off during periods of low run-off.

Cooperation.—Gage-height records furnished by the Canadian Department of Public Works.

Daily gage height, in feet, of Rainy Lake at Ranier, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	8.56	8.18	8.1	8.10	7.73	6.96	5.50	4.69	4.46	(a)	3.42	2.44
2	8.56	8.18	8.1	8.12	7.68	6.96	5.44	4.68	4.44	4.10	3.38	2.42
3	8.53	8.18	8.12	8.07	7.65	6.89	5.40	4.71	4.45	4.10	3.33	2.42
4	8.48	8.20	8.05	8.60	7.61	6.85	5.33	4.73	4.44	4.16	3.20	2.42
5	8.45	8.25	8.05	8.00	7.60	6.77	5.28	4.73	4.43	4.12	3.25	2.40
6	8.44	8.21	8.05	8.00	7.60	6.70	5.21	5.21	4.40	4.08	3.25	2.37
7	8.40	8.18	8.10	8.00	7.57	6.70	5.16	5.16	4.35	4.05	3.28	2.35
8	8.38	8.18	8.10	7.98	7.55	6.70	5.14	5.14	4.34	(a)	3.25	2.35
9	8.35	8.20	8.07	7.95	7.53	6.60	5.10	5.10	4.32	4.00	3.23	2.30
10	8.32	8.15	8.10	7.95	7.50	6.50	5.05	5.05	4.35	3.98	3.10	2.20
11	8.30	8.16	8.05	7.95	7.50	6.48	4.90	4.90	4.28	3.98	3.05	2.17
12	8.27	8.20	8.10	7.90	7.47	6.46	4.90	4.90	4.10	3.95	3.05	2.22
13	8.26	8.20	8.05	7.88	7.44	6.45	4.85	4.70	(a)	3.90	3.00	2.25
14	8.28	8.20	8.05	7.90	7.41	6.41	4.80	4.70	4.20	3.88	2.90	2.22
15	8.26	8.15	8.05	7.90	7.37	6.36	4.70	4.70	4.23	3.90	2.85	2.20
16	8.28	8.15	8.05	7.90	7.35	6.30	4.73	4.70	4.30	3.88	2.90	2.17
17	8.30	8.15	8.05	7.85	7.31	6.25	4.73	4.70	4.35	3.82	2.87	2.15
18	8.31	8.15	8.09	7.84	7.35	6.20	4.70	4.66	4.40	3.76	2.86	2.10
19	8.31	8.15	8.08	7.85	7.30	6.16	4.70	4.65	4.40	3.76	2.82	2.05
20	8.28	8.19	8.05	7.85	7.27	6.10	4.70	4.70	4.35	3.74	2.77	2.10
21	8.26	8.17	8.05	7.84	7.23	6.05	4.70	4.67	4.30	3.72	2.70	2.07
22	8.22	8.15	8.03	7.83	7.20	6.00	4.70	4.65	4.30	3.75	2.65	2.05
23	8.22	8.15	8.02	7.84	7.20	5.96	4.71	4.65	4.28	3.70	2.65	2.10
24	8.21	8.15	8.02	7.83	7.15	5.92	4.70	4.60	4.24	3.64	2.65	2.00
25	8.18	8.20	8.06	7.80	7.10	5.89	4.72	4.58	4.25	3.55	2.62	1.92
26	8.20	8.2	8.10	7.78	7.05	5.84	4.70	4.55	4.20	3.60	2.65	1.90
27	8.20	8.15	8.10	7.76	7.02	5.80	4.70	4.60	4.15	3.55	2.60	2.00
28	8.20	8.1	8.10	7.76	7.00	5.70	4.70	4.56	4.15	3.55	2.55	2.02
29	8.20	8.1	8.10	7.75	....	5.65	4.70	4.54	4.15	3.55	2.55	2.00
30	8.19	8.1	8.10	7.74	....	5.62	4.70	4.52	4.15	3.50	2.49	2.02
31	8.17	....	8.10	7.74	....	5.50	....	4.48	....	3.45	2.46	....

a Gage not read owing to wind.

NOTE.—Gage heights referred to the same gage datum as those previously published in water-supply papers containing records for this drainage basin.

RAINY RIVER AT INTERNATIONAL FALLS, MINN.

LOCATION.—In sec. 34, T. 71 N., R. 24 W., at dam and powerhouse of Minnesota & Ontario Power Co.

DRAINAGE AREA.—14,600 square miles.

RECORDS AVAILABLE.—March 1, 1907, to September 30, 1917.

DISCHARGE.—Determined by Canadian Department of Public Works from power-house records.

EXTREMES OF DISCHARGE.—Maximum daily discharge during year, 12,700 second-feet April 13; minimum daily discharge, 1,450 second-feet December 5.

1907–1917: Maximum daily discharge, 37,300 second-feet June 7, 1916; minimum discharge, 431 second-feet April 21, 1909.

WINTER FLOW.—Determined from power-house records.

REGULATION.—Except during periods of high discharge, the flow is completely regulated at the dam and power plant of the Minnesota & Ontario Power Co. The plant is run on a 24-hour basis, so that except on Sunday the flow is fairly uniform; it is in fact much more uniform than the natural flow, use being made of the storage capacity of Rainy Lake, which has an area of about 344 square miles.

COOPERATION.—Estimates of flow through the power house are furnished by the Canadian Department of Public Works.

Daily discharge, in second-feet, of Rainy River at International Falls, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	11,300	11,200	10,600	8,720	10,700	10,800	8,980	10,300	10,400	9,340	9,660	8,350
2	10,800	11,200	10,700	10,800	10,800	10,700	9,540	10,300	10,400	7,030	9,870	7,430
3	12,100	11,200	5,760	10,800	10,700	10,600	10,500	10,400	7,260	8,380	9,980	4,260
4	11,400	11,200	9,690	10,900	8,260	8,610	10,400	10,400	9,560	7,480	9,920	6,420
5	11,000	9,660	10,700	10,800	9,330	8,950	10,500	10,400	10,400	9,090	5,540	8,400
6	11,100	9,450	10,700	10,900	10,800	10,600	10,400	9,350	10,300	9,970	9,510	8,370
7	11,000	11,000	10,700	10,000	10,800	10,600	10,400	9,800	10,500	10,000	9,880	8,390
8	9,960	11,100	10,700	9,150	10,800	10,600	8,890	10,400	10,500	8,920	9,610	8,310
9	10,300	11,100	10,700	10,800	11,000	10,700	9,170	10,400	10,400	9,360	9,780	7,890
10	11,200	11,000	9,360	10,800	10,700	10,700	10,400	10,500	9,060	10,000	10,000	7,850
11	11,300	11,100	8,340	10,900	8,120	8,470	10,400	10,400	9,510	10,000	10,100	8,080
12	11,300	8,730	10,700	10,900	9,930	9,180	11,600	10,400	9,960	9,870	8,330	7,220
13	11,300	9,020	10,900	10,800	10,800	10,500	12,700	9,680	8,330	9,920	9,800	7,140
14	11,300	11,000	10,700	7,940	10,700	10,500	12,500	9,710	7,350	10,000	10,300	7,380
15	9,870	11,200	10,700	9,470	10,800	10,500	8,940	10,400	7,380	9,580	8,080	7,380
16	10,000	11,200	10,700	10,900	10,800	10,400	9,230	10,700	7,830	9,900	8,340	6,780
17	11,300	11,200	5,700	10,800	9,220	10,400	10,500	10,400	7,760	9,880	8,480	7,160
18	11,300	10,900	9,060	10,900	7,830	9,320	10,600	10,300	6,450	9,960	9,060	7,450
19	11,300	8,880	10,200	10,800	9,760	9,400	10,600	10,600	6,780	9,940	7,750	7,380
20	11,200	8,450	10,200	10,800	10,700	10,400	10,500	9,080	9,640	9,920	9,020	7,200
21	11,200	11,200	10,600	9,700	10,600	10,500	10,400	9,860	10,500	9,950	8,850	6,990
22	10,300	8,150	10,800	8,400	10,800	10,400	9,160	10,300	10,300	9,200	8,930	6,780
23	9,680	5,510	10,800	11,900	10,800	10,300	9,960	10,500	10,400	8,740	9,050	5,120
24	11,300	9,660	9,600	10,800	10,800	10,400	10,300	10,600	9,850	9,960	9,430	6,300
25	11,200	9,440	1,450	10,800	7,960	8,250	10,200	10,500	10,000	9,860	9,080	6,320
26	11,200	7,380	7,310	10,700	9,690	9,120	10,300	10,400	10,400	10,000	7,480	6,250
27	11,200	10,400	10,200	10,500	10,700	10,400	10,400	7,980	10,400	9,890	8,550	6,300
28	11,200	10,900	10,600	9,510	10,600	10,600	10,600	9,720	10,100	9,900	9,110	6,230
29	9,740	10,700	9,020	9,800	......	10,400	9,470	10,300	10,400	8,430	8,900	6,210
30	9,950	10,600	10,700	10,700	......	10,400	10,100	10,400	10,400	9,780	9,030	4,050
31	11,200	......	7,640	10,800	......	10,400	......	10,400	......	9,910	8,990	......

Monthly discharge, in second-feet, of Rainy River at International Falls, Minn., for the year ending Sept. 30, 1917.

Month.	Maximum.	Minimum.	Mean.
October	12,100	7,870	10,900
November	11,200	5,510	10,100
December	10,900	1,450	9,530
January	11,900	7,940	10,400
February	11,000	7,830	10,200
March	10,800	8,250	10,100
April	12,700	8,890	10,300
May	10,700	7,980	10,200
June	10,500	6,450	9,420
July	10,000	7,030	9,490
August	10,300	5,540	9,040
September	8,400	4,050	6,980
The year	12,700	1,450	9,710

NOTE.—Monthly and yearly discharge computed by engineers of the United States Geological Survey from daily-discharge record furnished by the Canadian Department of Public Works.

KAWISHIWI RIVER NEAR WINTON, MINN.

LOCATION.—In sec. 20, T. 62 N., R. 11 W., in a pond above lower dam of St. Croix Lumber Co. at Kawishiwi Falls, 500 feet above Fall Lake, 3,000 feet below Garden Lake, near western line of Lake County, 2½ miles east of Winton, St. Louis County.

DRAINAGE AREA.—1,200 square miles.

RECORDS AVAILABLE.—June 21, 1905, to June 30, 1907; and October 14, 1912, to September 30, 1917.

GAGE.—Stevens water-stage recorder installed the last part of September, 1912, at a point just above right end of dam. Well was attached to timbers bolted to the vertical rock wall of the right bank of the river. Auxiliary staff gage was also attached to one of these timbers. The gage shelter was supported by timbers which were bolted to the horizontal portion of the rock wall above all possible high water. On May 27, 1913, the Stevens was replaced by a Friez water-stage recorder. During the high water of June, 1914, the well together with the float and weight were carried away by logs. At this time a concrete well was installed by the International Joint Commission a little below the dam and outside the river channel, and connected with the pool above the dam by a pipe through the dam. The gage was repaired and again put in operation about July 1, 1914. Both water-stage recorders refer to the same datum.

DISCHARGE MEASUREMENTS.—Made from cable about 1,000 feet above gage.

CHANNEL AND CONTROL.—At the gage the river flows through a small deep pool formed by a timber dam without openings, which constitutes the control and is permanent unless the dam is destroyed or alterations are made in the crest. About 200 feet above the dam is a decided falls. Banks not overflowed in the vicinity of the gage. At the measuring section the bed of the stream is rock and bowlders; rough; current swift except at low stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.25 feet 8 p. m. June 20 (discharge, 3,140 second-feet); minimum discharge recorded 17 second-feet April 17.

1905–1907 and 1912–1917: Maximum stage recorded, 7.2 feet April 30 and May 7, 1916 (discharge, 5,370 second-feet); no flow August 24, 25, 30, 31, and September 1, 1915, August 6 and 8, 1906, and April 23, 24, and 26, 1907.

ICE.—Stage-discharge relation not seriously affected by ice; open-channel rating curve assumed applicable. The operation of the water-stage recorder is affected by ice, and the flow from December to March, which is very constant during this part of the year, is computed from weekly reading of the staff gage.

REGULATION.—The St. Croix Lumber Co. has a dam at the outlet of Garden Lake to control the level of water in that lake and store water to be used in driving logs over the stretch of rapids between Garden and Fall Lakes. This dam is capable of holding the water in Garden Lake about 7 or 8 feet above its natural level at low water before water will flow over the gates. When the water in Garden Lake is held at a high stage the elevation of water is considerably higher in Farm Lake, and it is understood that the elevation of the surface of White Iron Lake is somewhat affected by the stage of Garden Lake. During the log driving season, April to November, the water in Garden Lake is held to the elevation of the top of the gates practically all the time. In November some of the gates are opened so that the lake is drawn down to low-water stage, and remains so until spring. The St. Croix Lumber Co. has a dam at the outlet of Birch Lake, which controls its elevation, and is capable of holding the water about 5 feet above low water. This dam is left open during the winter and until the high water of the spring break-up has passed. It is then closed and the lake is held as high as possible during the summer. A number of low dams in Stony River are used for sluicing logs off rapids but create no large amount of storage back of them. Large volumes of water are allowed to pass through the sluices of the dam at the outlet of Harden Lake for a few hours at a time, at irregular intervals, when desired to drive logs from Garden Lake to Fall Lake; when the gates are closed there is only a slight flow caused by leakage through the dam. At times some of the gates are partly opened to allow passage of sufficient water to prevent flow over crest of dam.

Accuracy.—Stage-discharge relation permanent; not usually affected by ice and seldom by logs. Rating curve fairly well defined below 2,890 second-feet. Continuous record from recording gage during the open-water period; weekly gage readings during winter. Daily discharge ascertained as follows: October 1 to December 31 and April 17 to May 16 from hourly gage heights; January 1 to April 11 determined from weekly gage heights; May 20 to September 30 by the discharge integrator. Discharge estimated for brief periods when gage was not working, or record fragmentary, for periods shown in footnote to daily-discharge table. Records good except those for low stages, which are subject to error.

The following discharge measurement was made by W. G. Hoyt:

September 12, 1917: Gage height, 1.05 feet; discharge, 245 second-feet.

Daily discharge, in second-feet, of Kawishiwi River near Winton, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	855	1,240	615				150	145	715	1,600	480	485
2	1,110	1,230	595				150	195	645	1,650	600	350
3	875	760	580				150	170	980	1,760	600	745
4	830	755	566				150	140	790	1,150	600	850
5	815	745	556				150	135	640	1,720	600	240
6	650	740	540				150	145	700	1,840	925	1,120
7	980	735	520				150	120	875	1,460	185	400
8	490	730	505				150	85	800	1,200	580	1,290
9	490	725	500				150		470	1,220	595	910
10	490	720	495				150		580	1,450	750	680
11	490	715	495				150		780	1,080	795	660
12	490	710	495				50	70	760	1,230	895	555
13	780	1,130	495				30		680	1,500	1,040	270
14	500	1,160	495				25		540	1,680	550	830
15	740	1,150	495		190		22		430	1,730	750	600
16	890	1,140	495	300		145	20		895	1,740	940	600
17	660	1,140	495				17	700	480	1,920	900	850
18	610	1,140	485				27	700	910	1,840	1,390	560
19	840	1,130	475				42	700	2,200	1,970		740
20	1,080	1,130	470				48	765	2,390	1,940		665
21	1,240	1,120	455				51	895	2,440	1,020		190
22	140	1,120	440				53	680	2,140	1,140	880	600
23	805	1,110	430				57	650	1,820	1,300		195
24	950	1,100	425				57	1,040	1,130	1,360		800
25	950	1,060	410				57	710	2,060	1,220		710
26	950	540	400				62	665	2,130	815		1,040
27	965	690	395				62	345	2,340	755	1,170	510
28	1,270	670	390				62	865	2,120	630	725	630
29	1,270	650	385		......		64	1,090	2,260	520	710	1,010
30	1,260	630	380		......		64	490	2,250	550	880	425
31	1,250	......	380		......		......	905	......	760	725	......

Note.—No gage readings, discharge estimated, Apr. 12–16, May 17–19, Aug. 2–5, 19–26, Sept. 15 and 16. Discharge based on record of stage for less than 24-hour periods, May 27, June 15, 17, July 29, 30, Sept. 14 and 15. Braced figures show mean discharge for period included.

Monthly discharge, in second-feet, of Kawishiwi River near Winton, Minn., for the year ending Sept. 30, 1917.

Month.	Maximum.	Minimum.	Mean.
October	1,270	140	830
November	1,240	540	920
December	615	380	479
January	......	......	300
February	......	......	190
March	......	......	145
April	......	17	84
May	1,090	......	416
June	2,440	430	1,260
July	1,970	520	1,330
August	......	......	788
September	1,290	190	650
The year	2,440	17	619

VERMILION RIVER BELOW VERMILION LAKE, NEAR TOWER, MINN.

Location.—In sec. 2, T. 63 N., R. 17 W., in St. Louis County, about 100 yards below dam at outlet of Vermilion Lake, 4 miles above Twomile Creek, which enters from the west, and about 18 miles across Vermilion Lake from Tower.

Drainage area.—507 square miles.

Records available.—May 17, 1911, to September 30, 1917, when station was discontinued.

Gage.—Vertical staff gage attached to a tree at the left bank; read by Mrs. A. E. Shively.

Discharge measurements.—From 1911–1913 made from a cable just below the gage; from 1914–1916 made from a boat about 1 mile below the gage.

Channel and control.—Bed composed of solid rock and large boulders. Heavy falls a short distance below the gage form permanent control; banks are not overflowed to any considerable extent.

Extremes of discharge.—Maximum stage recorded during year, 1.7 feet October 1–5 and July 5 (discharge, 397 second-feet); minimum stage recorded, 0.70 foot March 4–12, April 5–6, and September 28–30 (discharge 130 second-feet).

1911–1917: Maximum stage recorded, 3.8 feet April 29 to May 7, 1916 (discharge, 2,050 second-feet); minimum stage recorded, 0.22 foot October 1 and 2, 1914 (discharge 60 second-feet).

Ice.—Stage-discharge relation not affected by ice, owing to the heavy fall at the control section, and to the proximity to Vermilion Lake.

Regulation.—At the outlet of Vermilion Lake, a few hundred feet above the gage, is a loose rock dam which is used to raise the water surface of the lake for aid in navigation. This dam has no gates, but was repaired on July 19, 1912, thus for a period reducing the flow below normal. From April 28 to May 10, 1914, parts of the dam were removed and for some time subsequent the flow exceeded normal.

Accuracy.—Stage-discharge relation permanent. Rating curve well defined. Gage read to quarter-tenths daily; fluctuations in stage so gradual that good results are obtained from one reading a day. Daily discharge ascertained by applying daily gage height to rating table. Records good.

The following discharge measurement was made by R. B. Kilgore:

September 13, 1917: Gage height, 0.88 foot; discharge, 156 second-feet.

Daily discharge, in second-feet, of Vermilion River below Vermilion Lake, near Tower, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	397	321	244	187	158	139	134	272	272	378	272	208
2	397	321	244	187	158	139	134	287	272	378	272	187
3	397	321	244	187	158	139	134	287	272	378	272	187
4	397	321	231	187	148	130	134	304	272	378	257	187
5	397	321	231	187	148	130	130	304	272	397	257	187
6	397	321	231	187	148	130	130	321	257	378	244	183
7	378	321	231	187	148	130	130	321	257	378	244	183
8	358	321	231	187	148	130	130	321	257	378	244	177
9	358	304	231	187	148	130	134	321	257	378	244	177
10	358	304	231	183	148	130	134	340	257	378	236	171
11	340	304	231	183	148	130	134	340	257	378	236	167
12	321	287	231	183	148	130	134	340	257	378	231	167
13	321	287	220	177	148	139	134	340	257	378	231	163
14	321	287	220	177	148	139	134	340	257	378	220	163
15	321	287	208	177	148	139	139	340	257	358	220	158
16	321	287	208	171	148	139	139	340	257	358	220	158
17	321	287	208	171	148	139	139	340	257	358	208	158
18	321	272	208	171	139	139	139	340	272	358	208	158
19	321	272	208	171	139	139	139	340	287	358	208	152
20	321	272	208	167	139	139	148	321	287	340	208	152
21	321	257	208	167	139	139	158	321	304	340	198	148
22	321	257	208	167	139	139	171	321	321	340	198	148
23	321	257	208	167	139	139	198	321	340	340	208	144
24	358	257	208	167	139	139	220	321	358	340	208	139
25	358	257	208	167	139	139	231	304	378	340	208	139
26	340	257	198	167	139	139	231	287	378	321	208	134
27	340	257	198	163	139	139	231	287	378	321	208	134
28	340	257	187	158	139	139	231	287	378	304	208	130
29	321	257	187	158	....	139	257	287	378	304	208	130
30	321	244	187	158	....	139	272	272	378	287	208	130
31	321	....	187	158	....	134	....	272	....	287	208	....

Monthly discharge of Vermilion River below Vermilion Lake, near Tower, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 507 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	397	321	346	0.682	0.79
November	321	244	286	.564	.63
December	244	187	216	.426	.49
January	187	158	175	.345	.40
February	158	139	146	.288	.30
March	139	130	136	.268	.31
April	272	130	163	.321	.36
May	340	272	314	.619	.71
June	378	257	296	.584	.65
July	397	287	354	.698	.80
August	272	198	226	.446	.51
September	208	130	161	.318	.35
The year	397	130	236	.465	6.30

LITTLE FORK RIVER AT LITTLE FORK, MINN.

LOCATION.—In sec. 9, T. 68 N., R. 25 W., at lower of two highway bridges at Little Fork, Koochiching County, about 1½ miles above mouth of Beaver Brook and 2½ miles above Big Fork & International Falls Railway Bridge.

DRAINAGE AREA.—1,720 square miles.

RECORDS AVAILABLE.—June 23, 1909, to September 30, 1917, when station was discontinued.

GAGE.—Chain gage attached to new steel bridge about 100 feet above the location of the vertical staff gage which was read prior to March 5, 1917, by G. H. French and Vernon Jamison. Chain gage was set to read the same as staff gage at a gage height of 6.5 feet.

DISCHARGE MEASUREMENTS.—Made from the bridge at medium and high stages; at low stages made by wading a short distance above the bridge.

CHANNEL AND CONTROL.—Bed composed of sand, gravel, and bowlders. Banks high and not subject to overflow. Control permanent up to the summer of 1915, but during the high water in June there was a decided shift.

EXTREMES OF DISCHARGE.—Maximum stage during year, 18.7 feet 10 a. m. April 22, caused by backwater from a log jam at the railroad bridge; maximum discharge probably occurred April 23 (mean for day estimated at 4,460 second-feet); minimum discharge (estimated at 40 second-feet), February 9–20.

1909–1917: Maximum stage recorded, 37 feet April 18, 1916 (discharge, 19,300 second-feet); minimum discharge, about 40 second-feet, September 5, 1910, and February 9–20, 1917.

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation permanent since high water of June, 1915 Rating curve used, well defined below 5,670 second-feet and poorly defined above that point. Gage read to quarter tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except for period when stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table mean daily gage height corrected for effect of ice by means of discharge measurements, observers' notes, and weather records. Open-water records good; winter records subject to error.

Discharge measurements of Little Fork River at Little Fork, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 12	R. B. Kilgore	7.11	551	Mar. 5[a]	S. B. Soulé	6.50	62
Dec. 26[a]	S. B. Soulé	6.41	117	June 27	.....do	7.55	685
Jan. 23[a]	.....do	6.25	64	Sept. 17	R. B. Kilgore	5.58	140

[a] Made through complete ice cover.

Daily discharge, in second-feet, of Little Fork River at Little Fork, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Sept.
1	790	1,200	425	135	50	60	185	3,680	586	167
2	756	1,320	380	130	50	60	185	3,560	518	167
3	790	1,320	321	120	50	60	185	3,240	502	167
4	722	1,320	307	115	55	60	185	2,800	485	158
5	654	1,240	321	110	55	60	200	2,590	470	158
6	620	1,200	335	105	50	65	255	2,490	470	177
7	552	1,160	350	100	50	65	280	2,340	440	177
8	518	1,120	350	95	45	70	280	2,240	425	167
9	502	1,120	335	90	40	75	425	2,140	395	158
10	485	1,080	321	85	40	85	520	2,040	380	158
11	518	968	294	85	40	90	790	1,940	350	148
12	552	932	294	85	40	90	1,080	1,840	335	139
13	518	896	307	85	40	95	1,360	1,640	321	139
14	502	860	281	85	40	95	1,640	1,560	307	148
15	518	824	281	85	40	100	1,900	1,560	281	139
16	485	790	268	80	40	105	2,190	1,480	281	130
17	485	722	281	75	40	110	2,390	1,440	307	139
18	518	688	268	70	40	115	2,590	1,360	335	139
19	586	654	244	65	40	115	2,800	1,320	425	158
20	654	620	198	65	40	120	3,020	1,240	455	158
21	722	586	167	65	45	130	3,460	1,200	502	148
22	722	518	148	65	45	140	3,860	1,160	620	139
23	722	518	139	65	50	150	4,460	1,040	722	148
24	688	518	132	60	50	160	4,400	968	756	148
25	688	502	124	60	55	160	4,400	860	860	127
26	722	502	117	60	55	170	3,980	790	790	123
27	756	502	138	55	60	170	3,460	756	722	122
28	790	485	158	50	60	180	3,410	688	654	122
29	896	485	148	50	....	180	3,630	688	654	123
30	932	455	139	50	....	180	3,680	654	654	122
31	1,040	....	139	45	....	185	....	620	....	....

NOTE.—Stage-discharge relation affected by ice Nov. 14-20 and Nov. 24 to Apr. 24. Gage not read July 1 to Aug. 31; no determinations of discharge.

Monthly discharge of Little Fork River at Little Fork, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 1,720 square miles.]

Month.	Discharge in second-fee.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,040	485	658	0.383	0.44
November	1,320	455	837	.487	.54
December	425	117	249	.145	.17
January	135	45	80.8	.047	.05
February	60	40	46.6	.027	.03
March	185	60	113	.066	.08
April	4,460	185	2,040	1.19	1.33
May	3,680	620	1,680	.978	1.13
June	860	281	500	.291	.32
September	177	122	147	.086	.10

UPPER MISSISSIPPI RIVER BASIN.

MISSISSIPPI RIVER AT ELK RIVER, MINN.

LOCATION.—In sec. 3, T. 121 N., R. 23 W., at highway bridge in town of Elk River, about 2,500 feet below mouth of Elk River, in Sherburne County.

DRAINAGE AREA.—14,500 square miles.

RECORDS AVAILABLE.—July 22, 1915, to September 30, 1917.

GAGE.—Chain gage bolted to the handrail of the bridge, downstream side, near right bank; read by W. H. Ebner.

DISCHARGE MEASUREMENTS.—Made from the downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; control not well defined. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum discharge occurred during period April 1–10, when gage was not read; discharge not known, although on basis of power plant records was probably about 34,000 second-feet and occurred about April 5; minimum stage 3.6 feet 7.50 a. m. September 3 and 7 p. m. September 5 (discharge, about 3,530 second-feet).

1915–1917: Maximum stage recorded during unobstructed channel, 10.8 feet April 7, 1916 (discharge, 27,000 second-feet); minimum stage recorded, 3.6 feet at 8 a. m. September 3 and 7 p. m. September 5 (discharge, about 3,530 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; discharge estimated from records of discharge at Coon Rapids power plant, computed by the Minneapolis General Electric Co., allowance being made for the discharge of the Crow and Rum rivers, entering between Coon Rapids and the station.

REGULATION.—Nearest dam above the station on the Mississippi is at St. Cloud, 40 miles upstream. An observed systematic diurnal fluctuation at the gage of about 0.1 foot is doubtless due to the regulation at St. Cloud, but most of the effect of regulation is equalized before reaching the station. The flow of the river is controlled by Government dams on the upper river for the purpose of increasing the low water open season flow in the interests of navigation.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 4,620 and 12,400 and fairly well defined between 12,400 and 26,300 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except when stage-discharge relation was affected by ice, for which period it was estimated from Coon Creek power-plant records (see heading "Ice"). Open water records good; winter records subject to error.

COOPERATION.—Records of discharge at Coon Rapids power plant, upon which are based estimates of discharge during the winter months, furnished by the Minneapolis General Electric Co.

Discharge measurements of Mississippi River at Elk River, Minn., during the year ending Sept. 30, 1917.

[Made by S. B. Soulé.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Apr. 12	8.19	17,800
June 1	4.40	5,640

Daily discharge, in second-feet, of Mississippi River at Elk River, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	8,880	7,260						16,000	5,800	5,500	4,340	4,340
2	8,880	7,310						16,000	6,100	4,910	4,910	4,340
3	8,880	7,310						16,000	5,500	5,200	4,620	3,790
4	8,560	7,000						15,400	5,200	5,200	4,620	4,340
5	8,880	7,000					24,000	15,000	4,620	6,400	4,620	3,530
6	8,560	6,400						13,400	5,200	4,340	4,060	5,200
7	8,560	6,400						12,400	5,500	4,620	4,620	4,910
8	8,560	6,700						12,100	6,100	5,500	6,400	4,910
9	8,240	7,000						12,400	5,800	6,400	4,910	4,620
10	8,240	7,000						12,100	5,500	5,500	4,910	4,340
11	8,240	7,000					19,100	11,400	5,200	5,500	4,910	4,340
12	7,930	6,700					18,100	10,800	5,200	6,700	5,500	4,910
13	7,930	6,100					16,700	10,200	4,910	5,800	5,800	5,500
14	8,240	5,800					15,700	9,200	5,500	6,100	5,200	5,500
15	7,620	4,340					15,400	8,560	5,500	5,800	5,500	5,500
16	7,310	4,620	4,800	4,600	4,200	4,000	15,000	8,560	5,500	5,800	5,800	5,200
17	7,620	4,340					14,700	9,200	5,200	4,910	5,800	5,500
18	7,310	4,620					14,000	8,560	4,910	5,200	5,200	4,340
19	7,310	4,340					14,000	8,560	5,200	5,800	5,200	6,100
20	7,620	4,620					13,000	7,620	5,200	5,200	4,620	4,620
21	7,260	5,500					15,700	7,310	5,500	5,910	4,620	5,500
22	7,260	5,500					17,700	6,400	4,340	5,200	4,620	5,500
23	7,310	5,200					18,400	6,700	4,620	5,200	5,500	5,500
24	7,620	5,800					19,100	7,930	4,620	4,340	4,910	5,500
25	7,620	4,060					19,400	7,000	5,500	4,620	4,340	4,910
26	7,310						19,400	6,400	5,500	4,620	4,340	5,500
27	7,620						18,800	5,800	5,800	4,620	4,340	5,800
28	7,310	5,500					17,700	5,500	5,800	4,060	4,340	5,500
29	7,310						17,400	5,200	5,500	4,060	4,060	5,500
30	7,310						16,700	6,100	5,500	4,060	4,340	5,500
31	7,620	....					....	6,700	....	4,060	4,340	....

NOTE.—Stage-discharge relation affected by ice Nov. 26 to Apr. 10; discharge estimated by comparison with records of discharge at Coon Rapids power plant, furnished by the Minneapolis General Electric Co., allowance being made for the discharge of Crow and Rum rivers, which enter between Coon Rapids and the station. Braced figures show mean discharge for periods or months included.

Monthly discharge of Mississippi River at Elk River, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 14,500 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	8,880	7,260	7,900	0.545	0.63
November			5,850	.403	.45
December			4,800	.331	.38
January			4,600	.317	.37
February			4,200	.290	.30
March			4,000	.276	.32
April			19,200	1.32	1.47
May	16,000	5,200	9,820	.677	.78
June	6,100	4,340	5,340	.368	.41
July	6,700	4,060	5,160	.356	.41
August	6,400	4,060	4,880	.337	.39
September	6,100	3,530	5,020	.346	.39
The year			6,730	.464	6.30

MISSISSIPPI RIVER AT ST. PAUL, MINN.

LOCATION.—At Chicago Great Western Railway bridge near foot of Robert Street, St. Paul, 6 miles below mouth of Minnesota River, in Ramsey County.

DRAINAGE AREA.—35,700 square miles.

RECORDS AVAILABLE.—March 1, 1892, to September 30, 1917. Observations of stage begun in 1873 by United States Signal Service and continued by United States Weather Bureau. Many discharge measurements made proir to 1900 by the United States Engineer Corps.

GAGE.—Chain gage installed May 9, 1913, on the handrail, downstream side, of Chicago Great Western Railway bridge near the foot of Robert Street; read by employees of United States Weather Bureau. From 1911 to May 9, 1913, the gage was a vertical staff gage, attached to a piling on the left bank of river, about 800 feet upstream from the present gage. Prior to 1911 a vertical staff gage on the Diamond Joe Line Wharf at the foot of Jackson Street, about 400 feet below the chain gage, was used. The datum of all three gages is the same, allowance being made for the slight slope in the river between them.

DISCHARGE MEASUREMENTS.—Up to 1915 made from the Chicago, St. Paul, Minneapolis & Omaha Railway bridge, 2 miles above the station; in November, 1915, and April, 1916, measurements were made from the Chicago Great Western Railway bridge, to which the gage is attached. During 1916 and 1917 measurements have been made from the Wabasha Street highway bridge, about 1,000 feet above station.

CHANNEL AND CONTROL.—Channel somewhat shifting. Control not well defined. Banks moderately high; have not been overflowed in recent years.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 16.2 feet at 8 a. m. April 8 (discharge, 70,200 second-feet); minimum discharge occurred during the period when river was frozen over, and was probably somewhat less than 5,000 second-feet.

1892–1917: Maximum stage recorded, 18.0 feet April 6, 1897 (discharge, 80,800 second-feet); highest known discharge occurred July 22, 1867, and amounted to 117,000 second-feet. Minimum stage recorded, −0.9 foot March 22, 1896 (discharge, 1,420 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; monthly mean flow generally ascertained from records obtained by United States Engineer Corps at lock and dam No. 2, below Minneapolis, allowance being made for the flow of the Minnesota River. During winter of 1916–17 records of flow past lock and dam No. 2 were not available, and determinations of flow were based on records obtained from the St. Anthony Falls Water Power Co., of Minneapolis.

REGULATION.—During extreme low water regulation of the flow through the turbines at the nearest dam in Minneapolis may cause diurnal fluctuation of stage at St. Paul. Flow is regulated by Government reservoirs on the headwaters at Lake Winnebigoshish, Leach Lake, Pokegama Lake, Sandy Lake, Pine River, and Gull Lake to increase the low-water open-season flow in the interests of navigation, but the effect of this regulation is very gradual at St. Paul.

ACCURACY.—Stage-discharge relation fairly permanent except as affected by ice. Rating curve well defined throughout. Gage read once daily to tenths, but this reading perhaps does not represent the mean daily stage accurately on account of artificial regulation at power plants in Minneapolis; occasional additional readings indicate that the error is not large. Daily discharge obtained by applying daily gage height to rating table except for period when stage-discharge relation was affected by ice, during which determinations were based on flow of Mississippi River at Minneapolis plus flow of Minnesota River. (See note regarding Ice.) Open-water records range from fair to good; winter records subject to error.

COOPERATION.—Gage-height record furnished by United States Weather Bureau. Data upon which mean monthly flow during winter periods have been based furnished by United States Corps of Engineers.

Discharge measurements of Mississippi River at St. Paul, Minn., during the year ending Sept. 30, 1917.

[Made by Soulé and Kilgore.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Dec. 6	2.89	7,810
Apr. 18	13.05	46,700

Daily discharge, in second-feet, of Mississippi River at St. Paul, Minn., for the year ending Sept. 30 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	13,300	11,000	7,010				31,100	38,500	18,100	17,500	8,420	5,910
2	12,800	10,800	7,800				35,000	37,900	18,700	16,600	7,600	7,010
3	12,800	10,800	8,000				36,200	37,300	18,700	15,800	7,800	5,910
4	12,800	10,600	8,420				41,600	36,700	19,700	14,900	7,600	5,730
5	13,000	10,400	8,000				52,600	36,200	19,200	14,100	7,600	5,730
6	12,800	10,600	8,000				58,000	35,000	20,600	14,400	7,400	5,560
7	12,500	9,920	8,630				63,700	33,500	21,000	13,600	7,800	5,560
8	12,200	9,920	8,630				68,600	32,000	21,300	13,000	7,600	6,450
9	12,000	10,100	7,600				67,000	30,200	21,300	12,800	8,210	6,270
10	12,500	10,400	6,270				65,300	29,800	21,300	13,800	8,210	6,090
11	12,000	9,920	5,730				62,000	28,200	21,000	14,100	8,000	5,910
12	11,800	9,920	5,730				58,800	26,700	21,300	13,300	8,000	5,910
13	11,500	9,920	5,910				55,600	25,200	21,300	13,800	8,210	6,090
14	11,500	8,000					53,400	23,700	21,600	13,000	8,630	6,450
15	11,500	7,200		5,100	4,500	4,300	54,100	22,300	22,000	12,800	8,210	6,630
16	11,500	6,270					51,100	21,000	22,000	12,000	8,000	6,630
17	11,000	7,200					48,300	20,000	22,000	11,500	8,210	6,450
18	11,300	7,200					46,200	19,300	21,300	10,800	7,800	6,630
19	10,800	7,800					43,600	18,700	19,700	10,400	7,400	6,270
20	11,000	8,000					42,200	18,100	18,100	10,800	7,600	6,270
21	11,000	8,210					39,100	17,800	16,300	10,100	7,200	6,450
22	11,000	8,420	5,100				38,500	16,900	15,200	9,920	7,010	6,270
23	10,800	8,420					39,700	16,000	13,800	10,100	6,450	6,630
24	10,600	7,600					39,700	15,500	13,600	10,100	7,010	6,630
25	10,800	6,450					40,300	16,300	14,100	10,100	6,820	6,630
26	11,000	5,390					41,000	16,000	14,600	10,100	6,450	6,630
27	11,000	6,090					41,000	15,500	15,800	10,400	6,270	6,270
28	10,800	6,630				13,000	40,300	15,200	16,000	10,100	6,270	6,820
29	10,800	8,000				15,500	40,300	15,500	17,200	9,260	6,090	6,630
30	10,600	7,800				17,500	39,700	15,200	16,000	8,840	6,450	6,630
31	10,800	......			......	19,000	......	16,600	......	8,210	6,270	......

NOTE.—Stage-discharge relation affected by ice Dec. 14 to Mar. 27. Braced figures show mean discharge for period included.

Monthly discharge of Mississippi River at St. Paul, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 35,700 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	13,300	10,600	11,600	0.325	0.37
November	11,000	5,390	8,630	.242	.27
December	8,630	....	6,050	.169	.19
January	....	....	5,100	.143	.16
February	....	....	4,500	.126	.13
March	19,000	....	5,840	.164	.19
April	68,600	31,100	47,800	1.34	1.50
May	38,500	15,200	24,100	.675	.78
June	22,000	13,600	18,800	.527	.59
July	17,500	8,210	12,100	.339	.39
August	8,630	6,090	7,440	.208	.24
September	7,010	5,560	6,300	.176	.20
The year	68,600	....	13,200	.369	5.01

CROW WING RIVER AT MOTLEY, MINN.

LOCATION.—Near north border of sec. 18, T. 133 N., R. 31 W., at highway bridge in Motley, Cass County, about a quarter of a mile north of Northern Pacific Railway station and 2 miles above mouth of Long Prairie River, the nearest tributary.

DRAINAGE AREA.—2,140 square miles.

RECORDS AVAILABLE.—June 10 to November 30, 1909; April 17, 1913, to September 30, 1917, when station was discontinued. Records for 1909 consist of discharge measurements and gage heights only.

GAGE.—Chain gage attached to upstream handrail of bridge near right bank, read by S. W. Jacobs. Prior to July 21, 1916, gage was a staff gage in two sections, the lower section attached to an old log bulkhead which constituted the abutment of a former bridge, and was about 20 feet above the upstream edge of the bridge, at the left bank; upper section was attached to an old piling just above the lower section.

DISCHARGE MEASUREMENTS.—Made from upstream side of the bridge.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; fairly permanent. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.2 feet at 6 p. m. April 5 when stage-discharge relation was affected by ice (mean discharge for day estimated at 3,600 second-feet); minimum open-water stage recorded, 5.70 feet August 28 and 29 (discharge, about 270 second-feet).

1913–1917: Maximum stage recorded, 11.5 feet April 5 and 6, 1916 (discharge, 9,440 second-feet); minimum open-water stage recorded, 5.70 feet August 28 and 29, 1917 (discharge, about 270 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—Nearest dam above station is at outlet of Lower Crow Wing Lake, about 67 miles above Motley; regulation at this point has very little effect at the gage.

ACCURACY.—Stage-discharge relation fairly permanent. Rating curve well defined between 450 and 4,790 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to the rating table except for period when stage-discharge relation was affected by ice for which it was obtained by applying to rating table mean daily gage heights corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good; winter records fair.

Discharge measurements of Crow Wing River at Motley, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 31	R. B. Kilgore	6.60	1,050	Apr. 10	R. B. Kilgore	7.55	2,290
Dec. 27[a]	S. B. Soulé	6.95	506	June 28	S. B. Soulé	6.28	701
Jan. 24[a]	.....do	7.36	489	Sept. 18	R. B. Kilgore	6.08	532
Mar. 6[a]	.....do	7.61	476				

[a] Made through ice.

Daily discharge, in second-feet, of Crow Wing River at Motley, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,360	990	650	510	470	470	1,420	1,980	875	621	450	332
2	1,290	930	650	500	470	470	1,830	1,980	842	594	450	332
3	1,290	930	680	490	470	470	2,440	1,900	842	549	443	350
4	1,290	930	680	490	470	475	3,260	1,830	831	504	422	332
5	1,290	930	710	490	470	475	3,600	1,760	842	495	394	350
6	1,230	930	710	485	470	475	3,260	1,690	800	495	380	350
7	1,170	930	710	460	470	460	2,920	1,550	810	549	387	350
8	1,170	908	710	475	460	500	2,760	1,480	800	558	415	350
9	1,110	908	680	470	460	510	2,760	1,420	770	558	408	368
10	1,050	930	680	470	450	520	2,600	1,360	730	585	387	350
11	1,050	930	650	470	450	530	2,060	1,290	760	585	374	350
12	1,050	800	650	475	450	550	1,830	1,290	875	576	374	387
13	1,050	468	625	480	450	560	1,690	1,170	908	567	380	459
14	990	580	625	485	450	570	1,550	1,170	886	558	380	486
15	990	625	600	490	460	580	1,480	1,110	800	549	380	504
16	990	710	600	480	460	600	1,420	1,170	750	540	368	540
17	1,050	770	600	470	460	610	1,290	1,110	720	531	368	531
18	1,050	770	580	475	470	620	1,420	1,170	750	513	368	522
19	1,050	770	580	480	470	640	1,620	1,290	711	504	368	522
20	1,050	805	565	485	470	650	1,830	1,230	675	495	368	648
21	1,050	840	555	490	470	660	2,200	1,170	666	468	368	702
22	1,050	840	535	490	470	670	2,280	1,110	621	468	368	702
23	1,050	770	535	490	470	690	2,440	1,050	612	443	350	702
24	1,050	650	535	490	470	700	2,520	1,050	740	436	350	675
25	1,050	510	510	485	470	710	2,280	1,050	810	422	350	675
26	1,050	535	510	480	470	710	2,200	990	831	415	350	675
27	1,050	555	505	470	470	710	2,130	930	740	401	344	648
28	1,050	600	510	470	470	710	1,960	930	684	394	300	648
29	990	625	490	470	......	710	1,830	908	630	380	270	630
30	990	650	490	470	......	710	1,900	908	630	374	310	630
31	990	......	490	470	......	940	......	908	......	450	326	......

NOTE.—Stage-discharge relation affected by ice Nov. 14 to Apr. 9. Discharge, Sept. 17, interpolated.

Monthly discharge of Crow Wing River at Motley, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 2,140 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,360	990	1,090	0.509	0.59
November	990	468	771	.360	.40
December	710	490	599	.280	.32
January	510	470	481	.225	.26
February	470	450	465	.217	.23
March	940	470	603	.282	.32
April	3,600	1,290	2,160	1.01	1.13
May	1,980	908	1,290	.603	.70
June	908	612	765	.357	.40
July	621	374	502	.235	.27
August	450	270	373	.174	.20
September	702	332	503	.235	.26
The year	3,600	270	800	.374	5.08

LONG PRAIRIE RIVER NEAR MOTLEY, MINN.

LOCATION.—On west line of sec. 19, T. 133 N., R. 31 W., at highway bridge 1 mile south of Motley and 2 miles above mouth of river, in Morrison County.

DRAINAGE AREA.—973 square miles.

RECORDS AVAILABLE.—June 10, 1909, to September 30, 1917, when station was discontinued.

GAGE.—Chain gage attached to downstream handrail of bridge, near middle of stream; read by Mrs. Clem Thompson. Prior to August 9, 1916, the gage was a staff attached to an overhanging stump on right bank of the river, about 100 yards above bridge.

DISCHARGE MEASUREMENTS.—Made from downstream side of highway bridge to which gage is attached; low-stage measurements made by wading a short distance above gage.

CHANNEL AND CONTROL.—Bed composed of light gravel; practically permanent, affected by aquatic plants during portion of the year; left bank low, subject to overflow; right bank high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded when control was unobstructed, 9.00 feet at 8.30 a. m. April 6 (discharge, 2,540 second-feet); minimum discharge 105 second-feet March 1–11.

1909–1917: Maximum stage during period, 15.0 feet, April 5, 1916 determined by leveling from flood marks (estimated discharge, 4,280 second-feet, allowance being made for backwater). A discharge of 39 second-feet was measured by current meter on February 27, 1914; absolute minimum probably about 30 second-feet.

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation probably permanent except as affected by ice and growth of aquatic plants. Rating curve used October 1 to July 30 fairly well defined between 78 and 1,730 second-feet; extension above 1,730 second-feet determined from area and mean velocity curves. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage heights to rating table; discharge August 1 to September 30, determined by shifting-control method owing to obstruction of the channel by vegetation. Discharge for periods when stage-discharge relation was affected by ice ascertained by applying to rating table gage height corrected for backwater by means of discharge measurements, observer's notes, and weather records. Open-water records fair; winter records subject to error.

Discharge measurements of Long Prairie River near Motley, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 14	R. B. Kilgore	6.02	433	Apr. 3[b]	S. B. Soulé	10.82	1,270
Dec. 28[a]	S. B. Soulé	6.10	139	11	R. B. Kilgore	7.46	1,370
Jan. 25[a]	.....do	6.39	126	June 28	S. B. Soulé	5.62	278
Mar. 7[a]	.....do	6.49	106	Sept. 19	R. B. Kilgore	5.35	142

[a] Made through complete ice cover. [b] Open water at measuring section; ice jam at control.

Daily discharge, in second-feet, of Long Prairie River near Motley, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	680	265	340	140	125	105	740	1,070	320	229	248	127
2	624	265	340	140	125	105	1,000	1,000	320	219	265	130
3	624	265	300	140	125	105	1,280	1,000	320	216	282	132
4	570	265	300	140	125	105	1,730	935	320	213	229	130
5	570	282	320	135	120	105	2,290	870	320	213	206	130
6	520	300	340	135	120	105	2,450	870	320	219	206	127
7	495	360	360	135	120	105	2,130	805	320	265	197	127
8	470	360	380	135	120	105	1,890	740	320	300	188	130
9	470	360	360	135	120	105	1,730	680	300	300	194	132
10	470	340	380	130	120	105	1,350	624	300	300	185	132
11	470	340	320	130	120	105	1,280	570	300	300	173	130
12	495	300	300	130	120	110	1,140	570	300	300	176	130
13	520	300	265	130	120	115	1,000	520	300	265	194	142
14	520	300	265	130	120	115	870	520	300	232	203	152
15	422	300	250	130	120	120	870	470	300	232	197	144
16	422	300	230	125	115	120	805	470	300	229	182	144
17	422	300	230	125	115	130	740	470	282	219	176	142
18	401	300	215	125	115	145	680	446	265	213	173	134
19	401	300	200	125	115	150	680	446	265	203	170	130
20	401	282	200	125	115	160	935	422	248	200	160	127
21	401	282	185	125	115	175	1,140	422	248	197	157	132
22	401	282	170	125	115	190	1,280	401	232	203	149	130
23	401	282	170	125	115	205	1,420	380	232	213	154	127
24	401	282	155	125	115	225	1,500	380	232	203	149	122
25	401	282	145	125	115	250	1,350	380	282	197	149	127
26	401	282	145	125	110	265	1,280	340	300	188	147	122
27	401	300	145	125	110	300	1,210	340	300	176	142	120
28	401	300	140	125	110	340	1,140	340	265	167	139	120
29	340	320	140	125	....	380	1,070	340	248	165	134	118
30	320	340	140	125	....	470	1,000	340	232	182	132	113
31	292	....	140	125	....	570	....	340	....	216	134	....

NOTE.—Stage-discharge relation affected by ice Dec. 9 to Apr. 5 and by aquatic plants Aug. 1 to Sept. 30.

Monthly discharge of Long Prairie River near Motley, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 973 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	680	320	456	0.469	0.54
November	360	265	301	.309	.34
December	380	140	244	.251	.29
January	140	125	130	.134	.15
February	125	110	118	.121	.13
March	570	105	184	.189	.22
April	2,450	680	1,270	1.30	1.45
May	1,070	340	532	.547	.63
June	320	232	286	.294	.33
July	300	165	225	.231	.27
August	282	132	180	.185	.21
September	152	113	130	.134	.15
The year	2,450	105	340	.349	4.71

ELK RIVER NEAR BIG LAKE, MINN.

LOCATION.—In sec. 23, T. 33 N., R. 27 W., at highway bridge 4 miles east of Big Lake, Sherburne County, three-fourths of a mile north of Bailey station on Northern Pacific and Great Northern railways, half a mile above Tebbetts Brook, and 4 miles below mouth of St. Francis River.

DRAINAGE AREA.—615 square miles.

RECORDS AVAILABLE.—April 15, 1911, to September 30, 1917, when station was discontinued.

GAGE.—Vertical staff gage attached to upstream edge of left abutment; read by Michael Tracy. Prior to April 7, 1916, the gage was a staff gage attached to a piling about 10 feet above the upstream edge of the bridge, near the right bank of the river.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and light gravel. Just below the gage is a slight rapids which constitutes the control at medium and low stages, and at which the bed consists of heavier gravel and cobblestones and is fairly permanent. From July to October the channel is usually obstructed by aquatic plants, which cause considerable backwater, that increases as the summer advances and reaches a maximum some time in September. No obstruction due to aquatic plants during the period April to September, 1917, due apparently to the change in control section. Right bank high and not subject to overflow; left bank subject to overflow at a stage of about 9 feet, and some of the water cuts across a point formed by a loop in the river, and does not pass under the bridge.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.88 feet April 6 (discharge, 2,850 second-feet); minimum discharge about 75 second-feet January 24, 25, 28, and 29.

1911–1917: Maximum stage recorded, 10 feet at 6.30 p. m. May 7, 1912 (discharge, 5,100 second-feet); minimum open-water stage recorded during period, 0.22 foot July 16, 1911 (discharge, 43.4 second-feet, measured by current meter); a discharge of 39 second-feet was measured by current meter on January 27, 1912.

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation not permanent; change in control occurred about April 4 and 5 caused by breaking of ice jam with flood stage. Rating curve used October 1 to April 4, well defined throughout; curve used April 5 to September 30 well defined between 124 and 2,930 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for period when stage-discharge was affected by aquatic plants, for which it was ascertained by applying to rating table mean daily gage height corrected for effect of backwater by means of discharge measurements, and for winter period by observer's notes and weather records. Records good for period when channel was unobstructed, winter records fair.

Discharge measurements of Elk River near Big Lake, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 16[a]	R. B. Kilgore	1.29	108	Apr. 13	S. B. Soulé	4.03	1,190
Jan. 16[a]	S. B. Soulé	1.65	118	May 24	.....do	1.60	207
Mar. 3[a]	.....do	1.84	93	Aug. 20	R. B. Kilgore	1.47	159
Apr. 7	.....do	6.49	2,590				

[a] Complete ice cover at control and measuring section.

Daily discharge, in second-feet, of Elk River near Big Lake, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	297	356	283	125	95	95	510	700	251	282	167	127
2	283	356	269	125	95	95	870	700	236	266	158	127
3	283	356	269	130	95	95	1,330	660	221	251	156	124
4	283	356	269	130	95	100	1,860	660	236	236	150	124
5	283	356	240	135	95	100	2,360	620	251	251	140	124
6	297	356	230	135	95	100	2,860	580	266	266	150	124
7	297	356	215	135	95	105	2,600	540	266	266	178	121
8	297	341	205	135	95	110	2,300	500	266	251	178	124
9	297	341	190	135	90	120	2,000	482	266	236	178	124
10	297	341	180	135	90	130	1,720	464	251	236	172	124
11	312	341	165	130	90	130	1,560	428	236	266	164	134
12	312	341	155	130	90	135	1,390	394	236	282	192	161
13	312	341	140	125	90	140	1,170	378	221	298	221	161
14	312	325	130	125	90	140	1,070	346	221	362	221	161
15	312	325	120	120	90	145	925	330	206	378	206	158
16	312	356	110	120	90	145	835	314	192	362	192	156
17	312	371	110	115	95	145	745	282	192	330	192	156
18	312	341	110	110	95	145	660	282	175	282	178	153
19	326	326	110	100	95	145	660	236	167	251	178	156
20	326	326	110	90	95	145	620	221	161	236	172	167
21	341	312	115	90	95	155	620	221	178	221	167	167
22	341	312	115	80	95	170	620	221	172	206	161	161
23	341	312	115	80	90	185	620	221	175	236	156	156
24	341	310	115	75	90	205	660	206	206	221	156	156
25	326	312	115	75	90	220	745	192	330	206	150	156
26	341	297	120	70	90	240	745	192	330	206	145	153
27	341	283	120	70	90	260	745	192	378	192	140	153
28	341	297	120	75	90	265	745	178	378	178	134	156
29	341	297	120	75	....	295	745	178	346	170	129	156
30	341	283	120	80	....	350	745	221	314	161	129	156
31	341	....	120	85	....	415	....	251	....	170	127	....

NOTE.—Stage-discharge relation affected by backwaters from aquatic plants Oct. 1–31, and by ice Nov. 14, 15, 24, and Dec. 5 to Apr. 4.

Monthly discharge of Elk River near Big Lake, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 615 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	341	283	316	0.514	0.59
November	371	283	331	.538	.60
December	283	110	158	.257	.30
January	135	70	108	.176	.20
February	95	90	92	.150	.16
March	415	95	169	.275	.32
April	2,860	510	1,170	1.90	2.12
May	700	178	367	.597	.69
June	378	161	244	.397	.44
July	378	161	250	.406	.47
August	221	127	166	.270	.31
September	167	121	146	.237	.26
The year	2,860	70	293	.476	6.46

CROW RIVER AT ROCKFORD, MINN.

LOCATION.—In sec. 29, T. 119 N., R. 24 W., at highway bridge at Rockford, about 400 feet below dam (not in use at present), about one-third mile below "Soo" Railway bridge and about a mile below junction of north and south branches. Between junction and station are outlets of Rebecca Lake and Lake Sarah, both very small streams.

Records available.—June 4, 1909, to September 30, 1917, when station was discontinued.

Drainage area.—2,520 square miles.

Gage.—Vertical staff gage attached to a piling a few feet above the right end of the bridge; read by George W. Florida.

Discharge measurements.—Made from the bridge or by wading about 600 feet below the gage.

Channel and control.—For most part bed of stream is composed of heavy gravel; practically permanent. Banks are not overflowed except during extreme floods.

Extremes of discharge.—Maximum stage recorded during year, 14.5 feet at 6 p. m. April 7, and 7 a. m. April 6 (discharge, 8,500 second-feet); minimum discharge, 75 second-feet (measured by current meter February 27).

1909–1917: Maximum stage recorded, 15.9 feet at 6 p. m. April 2 and 7 a. m. April 3, 1916 (discharge, 10,600 second-feet); minimum open-water stage recorded, 4.55 feet January 29 and February 5, 1911 (discharge, 34 second-feet); true minimum, probably about 30 second-feet, occurred in February, 1915.

Ice.—Stage-discharge relation seriously affected by ice. Prior to the winter of 1911–12, little ice formed at the control, and the open-water rating curve was applicable throughout the year. Before the dam just above the station was destroyed the temperature of the large body of water back of the dam was considerably above freezing, and the water did not freeze quickly when released; but since the destruction of the dam natural conditions exist and ice forms.

Regulation.—On the North, Middle, and South forks of Crow River there are seven power plants with small storage, but the regulation at the various points is so slight that no appreciable effect is observed at the gage. The dam immediately above the gage was partly destroyed May 31, 1911, and has not since been repaired.

Accuracy.—Stage-discharge relation practically permanent except as affected by ice. Rating curve well defined between 90 and 10,700 second-feet. Gage read to hundredths twice daily. Owing to effect of ice on gage there is some question as to the gage datum used during the winter and early spring. Daily discharge ascertained by applying mean daily gage height to rating table except during period when stage-discharge relation was affected by ice, for which it was roughly estimated from discharge measurements and observer's notes. Open-water records good except for flood stages, for which they are fair; winter records roughly approximate.

Discharge measurements of Crow River at Rockford, Minn., during the period Oct. 1, 1916, to Oct. 4, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 12[a]	S. B. Soulé	4.83	97	May 28	S. B. Soulé	6.67	1,020
Feb. 27[a]	.....do	5.37	75	June 19	.....do	6.40	857
Apr. 10	.....do	13.91	7,840	Oct. 4	R. B. Kilgore	4.84	111

[a] Made through complete ice cover.

Daily discharge, in second-feet, of Crow River at Rockford, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	610	445					6,100	4,230	1,450	304	220	102
2	610	445					7,560	4,050	1,660	327	214	102
3	610	420					5,990	4,050	1,900	472	211	108
4	610	420					5,990	3,870	1,870	555	220	110
5	610	420					6,810	3,690	1,800	528	214	106
6	610	395					7,560	3,510	1,730	500	208	104
7	610	395					8,360	3,330	1,730	500	196	106
8	582	370	240	110			8,500	3,150	1,590	472	190	106
9	582	370					8,080	2,970	1,520	445	178	108
10	582	395					7,690	2,810	1,520	472	166	110
11	582	345					7,430	2,650	1,450	472	166	110
12	582	336					7,050	2,490	1,450	445	184	114
13	555	336				110	6,690	2,330	1,380	395	202	120
14	555	345					6,210	2,250	1,380	345	202	130
15	555	336			80		5,880	2,090	1,310	336	187	139
16	500	327					5,550	1,940	1,250	327	178	151
17	472	322					5,440	1,800	1,190	300	163	160
18	472	309					5,130	1,730	1,010	284	154	154
19	472	318					5,030	1,590	860	268	145	148
20	445	309					4,930	1,450	775	252	136	136
21	445	304					4,630	1,380	692	240	130	128
22	472	300					4,430	1,310	638	260	126	122
23	500	309					4,230	1,250	610	318	126	124
24	500		130	90			4,430	1,130	610	318	126	126
25	472						4,330	1,070	610	314	124	122
26	472						4,630	1,010	555	304	122	126
27	500	290					4,330	1,010	472	284	116	126
28	472						4,330	950	395	268	114	122
29	472				......	750	4,230	1,310	345	228	108	118
30	472				......		4,140	1,310	313	228	102	118
31	445	......			......		......	1,380	......	214	102	......

NOTE.—Stage-discharge relation affected by ice Nov. 24 to Mar. 31. Braced figures show mean discharge for period included.

Monthly discharge of Crow River at Rockford, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 2,520 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	610	445	530	0.210	0.24
November	445	....	343	.136	.15
December	....	....	183	.073	.08
January	....	....	99.7	.039	.04
February	....	....	80.0	.032	.03
March	....	....	234	.093	.11
April	8,500	4,140	5,860	2.33	2.60
May	4,230	950	2,230	.885	1.02
June	1,870	313	1,130	.448	.50
July	555	214	354	.140	.16
August	220	102	169	.067	.08
September	160	102	122	.048	.05
The year	8,500	....	941	.373	5.06

MINNESOTA RIVER NEAR MANKATO, MINN.

LOCATION.—In sec. 14, T. 108 N., R. 27 W., in Blue Earth County, at Sibley Park, 2 miles above center of Mankato and 1,000 feet below mouth of Blue Earth River.

DRAINAGE AREA.—14,600 square miles.

RECORDS AVAILABLE.—May 20, 1903 to September 30, 1917.

GAGE.—Chain gage on right bank of river, about 1,000 feet below mouth of Blue Earth River; read by Clarence Staley, observer for United States Weather Bureau. The gage support is a substantial cantilever structure, supported by two heavy posts resting in concrete footings, constructed and maintained by the United States Engineer Corps.

DISCHARGE MEASUREMENTS.—Made from highway bridge in center of Mankato, by wading a short distance below gage, or at extreme high stages, by boat near gage.

CHANNEL AND CONTROL.—Bed composed of sand and light gravel; fairly permanent except during high stage; banks moderately high and not subject to overflow except at stages above gage height of 15 feet. Control not well defined.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 15.8 feet April 5 (discharge, about 26,900 second-feet); minimum discharge 248 second-feet measured by current meter February 28.

1903–1917: Maximum stage recorded, 21.2 feet June 26, 1908 (discharge, 43,800 second-feet); minimum stage recorded, 0.5 foot August 31, September 1 and 2, 1911 (discharge, 89 second-feet). The highest known stage of this river occurred in 1881, and is shown in Mankato by a well-marked line which was approximately 27 feet above the zero of the present gage (discharge estimated 65,000 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—The nearest dam on Minnesota River is at Minnesota Falls, 140 miles upstream. A dam on Blue Earth River at Rapidan, a few miles above the mouth, controls the flow of that river, which is about 20 per cent of that at the Mankato station, and produces considerable daily fluctuation at the gage, amounting at times to more than 1 foot.

ACCURACY.—Stage-discharge relation not permanent; change in control section probably occurred during high water of June or was gradual between June and September. Rating curve used October 1 to June 15, well defined throughout; curve used June 16 to September 30 poorly defined. Gage read to tenths once daily. This reading does not represent accurately the mean daily stage on account of fluctuation caused by artificial regulation. Daily discharge ascertained by applying the daily gage height to rating table except for period when stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records fair; winter records poor.

COOPERATION.—Gage-height record furnished by United States Weather Bureau.

Discharge measurements of Minnesota River near Mankato, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 10	R. B. Kilgore	2.15	1,330	Feb. 28[a]	S. B. Soulé	1.59	248
Dec. 22[a]	....do	1.90	554	June 15	....do	9.13	11,100
Jan. 13[a]	S. B. Soulé	1.71	393	Sept. 29	R. B. Kilgore	1.30	445

[a] Measurement made from complete ice cover.

Daily discharge, in second-feet, of Minnesota River at Mankato, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug	Sept.
1	1,440	1,140	910	490	320	250	21,600	13,800	11,200	7,700	1,750	570
2	1,380	1,140	910	480	320	250	22,100	13,800	12,900	7,340	1,510	520
3	1,380	1,080	860	470	320	250	22,400	13,600	11,800	6,470	1,220	520
4	1,320	1,080	860	460	310	250	25,500	13,400	11,400	5,990	1,360	520
5	1,320	1,080	860	450	310	250	26,900	12,700	10,700	5,830	1,080	520
6	1,320	1,140	860	440	310	260	25,500	12,500	11,200	6,150	945	520
7	1,260	1,140	910	430	310	260	24,700	12,500	11,400	6,470	1,010	520
8	1,320	1,140	910	430	300	260	22,900	12,000	12,500	6,150	1,010	470
9	1,380	1,140	910	420	300	260	24,700	11,600	15,000	5,830	1,080	520
10	1,380	1,140	910	410	300	260	25,000	11,400	15,500	5,530	1,010	520
11	1,260	1,080	910	400	300	270	23,700	10,100	16,000	5,830	945	470
12	1,260	1,080	860	390	290	270	23,400	9,270	16,200	4,950	945	470
13	1,260	1,080	860	390	290	270	21,400	8,490	15,200	4,400	880	470
14	1,200	1,080	860	390	290	270	20,900	7,930	12,500	4,010	880	470
15	1,200	1,080	860	380	280	270	19,400	8,110	10,900	3,760	945	470
16	1,260	1,080	810	370	280	280	18,400	6,880	10,100	3,640	945	470
17	1,260	1,080	760	370	280	280	16,900	6,230	9,050	3,080	945	470
18	1,260	1,080	710	370	280	280	16,000	5,330	8,270	3,080	880	420
19	1,260	1,020	660	370	270	280	15,200	5,770	8,460	2,980	815	470
20	1,260	960	635	360	270	280	14,500	5,620	6,980	2,980	815	470
21	1,200	960	590	360	270	370	14,100	5,920	5,990	3,080	815	470
22	1,200	960	550	360	270	490	14,500	6,230	5,530	3,190	750	520
23	1,200	960	550	360	250	610	14,300	5,770	5,680	3,300	750	420
24	1,200	910	550	350	260	1,080	14,500	5,470	5,090	3,300	690	520
25	1,260	910	530	350	250	1,870	15,000	5,470	8,460	3,190	630	420
26	1,260	960	530	350	250	8,300	14,800	5,620	9,450	3,760	690	420
27	1,200	960	510	340	250	10,300	15,200	5,920	10,300	3,760	690	420
28	1,140	910	510	340	250	12,500	14,500	5,920	10,500	3,520	630	420
29	1,140	910	510	340	....	14,800	14,300	5,770	9,250	3,190	630	420
30	1,140	910	490	330	....	14,800	14,300	6,230	8,270	2,680	630	470
31	1,140	....	490	330	....	14,800	....	6,390	....	2,380	570	....

NOTE.—Stage-discharge relation affected by ice Dec. 16 to Mar. 31.

Monthly discharge of Minnesota River at Mankato, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 14,600 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,440	1,140	1,260	0.086	0.10
November	1,140	910	1,040	.071	.08
December	910	490	730	.050	.06
January	490	330	390	.027	.03
February	320	250	285	.020	.02
March	14,800	250	2,750	.188	.22
April	26,900	14,100	19,200	1.32	1.47
May	13,800	5,330	8,570	.587	.68
June	16,200	5,090	10,500	.719	.80
July	7,700	2,380	4,440	.304	.03
August	1,750	570	918	.063	.75
September	570	420	478	.033	.04
The year	26,900	250	4,210	.288	3.92

CHIPPEWA RIVER NEAR WATSON, MINN.

LOCATION.—On line between secs. 10 and 15, T. 118 N., R. 41 W., at highway bridge about 2½ miles northeast of Watson, Chippewa County, about 2 miles below mouth of Dry Weather Creek and 10 miles above mouth of river.

DRAINAGE AREA.—1,940 square miles.

RECORDS AVAILABLE.—Apr. 27, 1910, to September 30, 1917, when station was discontinued. From July 6 to September 17, 1909, four discharge measurements were made at the station.

GAGE.—Chain gage attached to downstream side of the bridge, near left bank of river; read by Clifford Bonde.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge to which gag[e] is attached or by wading a short distance above gage.

CHANNEL AND CONTROL.—Bed consists partly of sand and light gravel and partly clay; shifts somewhat. The right bank slopes gradually, and the width of the stream increases rapidly as stage increases from 10 to 12 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 17.86 feet April 4 (discharge, assuming there was no backwater from ice jams, about 9,600 second-feet); minimum stage recorded 4.55 feet September 5 (discharge 21 second-feet).

1910–1917: Maximum stage recorded April 4, 1917; minimum stage recorded during open-water periods 3.90 feet August 7, 8, and 9, 1910 (discharge, 5 second-feet). A discharge of 1.7 second-feet was measured by current meter February 9, 1912.

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation not permanent; change occurred probably during the high water of April and May. Rating curve used October 1 to November 11, well defined between 358 and 4,250 second-feet; curve used April 6 t[o] September 30, poorly defined throughout. Gage read to hundredths once daily; observations discontinued during winter. Daily discharge ascertained by applying gage height to rating table. Records fair.

Discharge measurements of Chippewa River near Watson, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Dis-charge.
		Feet.	*Sec.-ft.*
Oct. 13	S. B. Soulé	8.09	51
Apr. 13	R. B. Kilgore	13.38	2,78
Sept. 22[a]	....do	5.03	6

[a] Made by wading 400 feet above gage.

Daily discharge, in second-feet, of Chippewa River near Watson, Minn., for the yea[r] ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	646	424	3,330	2,300	623	248	86	5
2	646	407	3,330	2,170	623	232	80	2
3	623	407	6,520	2,110	578	217	80	2
4	623	407	9,700	1,990	578	202	100	2
5	600	390	8,620	1,930	578	194	100	2
6	600	374	8,080	1,830	600	187	86	2
7	578	374	7,720	1,780	623	172	86	4
8	578	358	3,680	1,690	600	180	80	3
9	578	358	3,560	1,610	578	172	74	3
10	556	342	3,220	1,530	556	164	80	4
11	556	342	2,930	1,450	535	172	80	2
12	556	....	2,750	1,410	517	157	86	6
13	556	....	2,590	1,300	499	164	107	6
14	535	....	2,440	1,300	463	172	107	4
15	535	....	2,300	1,240	445	164	114	3
16	515	....	2,230	1,200	428	164	107	7
17	496	....	2,050	1,140	411	157	100	5
18	496	....	1,930	1,100	377	150	107	6
19	477	....	1,930	1,080	344	142	100	5
20	468	....	2,300	1,020	344	135	86	6
21	459	....	2,440	986	328	121	74	7
22	459	....	2,440	930	328	135	68	6
23	459	....	2,370	903	312	121	49	7
24	459	....	2,370	876	296	114	51	5
25	459	....	2,440	849	280	121	56	5
26	459	....	2,510	822	264	121	54	6
27	459	....	2,440	770	248	114	50	4
28	459	....	2,370	719	296	93	36	7
29	441	....	2,370	694	280	86	27	4
30	424	....	2,300	670	264	80	23	3
31	424	....	....	670	....	100	68	....

NOTE.—Gage not read Oct. 20 and Apr. 3; discharge interpolated.

Monthly discharge of Chippewa River near Watson, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 1,940 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	646	424	519	0.268	0.31
November 1-11	424	342	380	.196	.08
April	9,700	1,930	3,510	1.81	2.02
May	2,300	670	1,290	.665	.77
June	623	248	440	.227	.25
July	248	80	153	.079	.09
August	114	23	77.5	.040	.05
September	80	21	49.7	.026	.03

ST. CROIX RIVER AT SWISS, WIS.

LOCATION.—In sec. 33, T. 42 N., R. 15 W., at highway bridge near post office of Swiss, Burnett County, about 2 miles above point where St. Croix River becomes boundary line between Wisconsin and Minnesota, 10 miles northeast of Danbury, Minn., on Minneapolis, St. Paul & Sault Ste. Marie Railway. Namakagon River enters from left about 3½ miles above station.

DRAINAGE AREA.—1,550 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale: 1 inch=6 miles).

RECORDS AVAILABLE.—March 20, 1914, to September 30, 1917.

GAGE.—Cast-iron staff gage bolted to concrete pier at left end of bridge; read by Capt. Richard Goldschmidt.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Gravel, smooth; acquatic plants during summer months may cause a small amount of backwater at the gage. Right bank high and not subject to overflow; left bank of medium height and may possibly be overflowed during extremely high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 3.05 feet at 6.40 a. m., July 21 (discharge, 2,840 second-feet); minimum discharge estimated at 710 second-feet February 22.

1914–1917: Maximum stage recorded, 6.73 feet at 6.45 a. m., April 22, 1916 (discharge, 8,480 second-feet); minimum discharge, February 22, 1917.

ACCURACY.—Stage-discharge relation practically permanent except as affected by backwater from grass October 1–19, and by ice November 15 to April 4. Two rating curves used during year, applicable as follows: October 1 to April 4, fairly well defined between 1,000 and 7,500 second-feet; April 5 to September 30, fairly well defined between 850 and 7,500 second-feet. Gage read to quarter-tenths twice daily. Daily discharge, except as noted below, ascertained by applying mean daily gage height to rating table; discharge October 1–29 determined by shifting-control method, owing to backwater from grass; discharge November 15 to April 4, estimated, because of ice, from discharge measurements, observer's notes, and weather records. Open-water records good; winter records fair.

Discharge measurements of St. Croix River at Swiss, Wis., during the year ending Sept. 30, 1917.

[Made by R. B. Kilgore.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 26 [a]	2.12	863	May 9	1.80	1,680
Jan. 25 [a]	2.28	734	Aug. 18	.90	909
Feb. 27 [a]	2.78	820			

[a] Complete ice cover.

Daily discharge, in second-feet, of St. Croix River at Swiss, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,350	1,270	1,130	850	790	790	2,000	2,070	1,450	1,210	1,170	885
2	1,310	1,270	1,130	865	775	790	2,130	2,070	1,450	1,170	1,130	913
3	1,310	1,270	1,100	880	780	790	2,200	2,070	1,450	1,130	1,060	864
4	1,350	1,270	1,100	870	780	800	2,280	1,980	1,450	1,060	1,020	815
5	1,310	1,270	1,070	865	790	815	2,270	1,890	1,490	1,130	963	843
6	1,270	1,200	1,070	855	805	810	2,070	1,800	1,490	1,290	990	885
7	1,270	1,200	1,040	850	800	810	2,070	1,760	1,530	1,410	990	878
8	1,240	1,270	1,010	860	790	905	2,170	1,710	1,530	1,450	1,100	906
9	1,200	1,240	980	865	780	1,000	2,070	1,620	1,530	1,450	1,100	885
10	1,160	1,270	950	860	765	1,020	1,980	1,580	1,490	1,410	1,060	843
11	1,200	1,200	890	855	760	1,040	2,070	1,530	1,450	1,450	1,020	857
12	1,200	1,130	865	860	750	1,040	1,980	1,450	1,370	1,450	1,020	962
13	1,240	1,130	840	865	760	1,040	1,980	1,410	1,290	1,370	983	1,130
14	1,240	1,070	815	830	765	1,070	1,980	1,370	1,250	1,330	955	1,210
15	1,200	1,040	790	790	760	1,100	1,890	1,370	1,210	1,250	934	1,210
16	1,200	1,010	790	765	755	1,120	1,800	1,330	1,170	1,250	934	1,170
17	1,240	1,010	790	740	745	1,140	1,800	1,290	1,170	1,210	920	1,130
18	1,270	1,010	815	735	740	1,160	1,800	1,290	1,130	1,130	920	1,060
19	1,310	1,040	815	730	735	1,190	1,890	1,290	1,170	1,100	934	990
20	1,350	1,070	815	740	730	1,280	2,070	1,250	1,210	2,370	913	955
21	1,350	1,100	815	750	720	1,380	2,170	1,210	1,250	2,780	892	934
22	1,350	1,130	840	760	710	1,440	2,170	1,210	1,250	2,470	885	920
23	1,310	1,130	840	765	715	1,500	2,170	1,170	1,250	2,370	906	906
24	1,310	1,160	865	775	720	1,560	2,070	1,130	1,290	2,070	920	892
25	1,310	1,160	865	785	750	1,630	2,070	1,130	1,370	1,710	906	864
26	1,270	1,160	865	780	780	1,740	2,070	1,130	1,450	1,530	927	843
27	1,310	1,160	860	780	820	1,860	1,980	1,100	1,490	1,410	913	850
28	1,310	1,130	850	780	800	1,820	1,980	1,060	1,450	1,290	885	878
29	1,270	1,130	845	775	....	1,770	1,980	1,100	1,370	1,170	878	885
30	1,270	1,130	840	780	....	1,820	2,070	1,130	1,330	1,100	892	864
31	1,240	....	845	790	....	1,860	....	1,290	....	1,060	864	....

Monthly discharge of St. Croix River at Swiss, Wis., for the year ending Sept. 30, 1917.

[Drainage area 1,550 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,350	1,160	1,270	0.819	0.94
November	1,270	1,010	1,150	.742	.83
December	1,130	790	908	.586	.68
January	890	730	808	.521	.60
February	820	710	763	.492	.51
March	1,860	790	1,230	.794	.92
April	2,280	1,800	2,040	1.32	1.47
May	2,070	1,060	1,440	.929	1.07
June	1,530	1,130	1,360	.877	.98
July	2,780	1,060	1,470	.948	1.09
August	1,170	864	968	.625	.72
September	1,210	815	941	.607	.68
The year	2,780	710	1,200	.774	10.49

ST. CROIX RIVER NEAR ST. CROIX FALLS, WIS.

Location.—In sec. 18, T. 34 N., R. 18 W., at power plant of Minneapolis General Electric Co., on Wisconsin side of St. Croix River, near St. Croix Falls, Polk County, Wis., about 50 miles above confluence of St. Croix and Mississippi rivers near Hastings, Minn. Apple River, draining an area wholly in Wisconsin, enters from the left about 20 miles below the station; Snake River, draining an area in Minnesota, enters from the right, about 35 miles above the station.

Drainage area.—5,930 square miles.

Records available.—January 10, 1902, to June 30, 1905; January 1, 1910, to September 30, 1917. Data for 1903 published in Water-Supply Paper No. 98, pages 176–177, under "St. Croix River near Taylors Falls, Minn."

Discharge.—Determinations of discharge based on kilowatt output of dynamo and exciters plus flow over dam and spillway, considered as a weir.

Extremes of discharge.—Maximum daily discharge during year, 17,700 second-feet April 5; minimum daily discharge 1,120 second-feet January 1, 1917.

1902–1905 and 1910–1917: Maximum daily discharge 35,100 second-feet April 23, 1916; minimum daily discharge 75 second-feet July 17, 1910. Minimum discharge caused by regulation.

Regulation.—Low-water flow controlled by operation of gates of power plant and by storage and release of water at Never's dam several miles upstream.

Accuracy.—Records have not been checked nor have any discharge measurements been made by engineers of the United States Geological Survey; probably reliable.

Cooperation.—Records furnished by the Minneapolis General Electric Co.

Daily discharge, in second-feet, of St. Croix River near St. Croix Falls, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,670	3,730	2,080	1,120	1,690	1,710	8,220	8,600	3,650	2,580	4,090	1,980
2	3,300	2,740	3,040	1,620	1,540	1,710	9,520	8,340	3,290	3,470	3,760	2,030
3	2,780	2,750	1,980	1,760	2,090	1,990	10,400	8,780	2,590	2,950	2,680	1,880
4	3,710	3,100	2,180	1,640	1,430	1,350	11,000	8,160	3,640	2,380	2,460	1,970
5	2,900	2,550	2,190	1,720	1,390	1,740	17,700	8,110	3,770	3,020	2,640	2,120
6	2,900	2,420	2,480	2,150	1,600	1,710	16,700	5,490	3,800	3,330	2,360	2,140
7	3,000	2,540	2,370	1,440	1,650	1,780	16,400	5,480	3,800	3,230	2,710	2,220
8	2,440	2,810	2,250	1,690	1,700	1,780	11,100	6,030	3,980	2,500	2,790	2,070
9	3,040	2,550	2,950	1,780	1,590	1,690	10,400	4,420	3,790	3,600	2,790	1,710
10	2,420	2,600	1,550	1,650	2,000	2,040	10,200	4,950	2,520	3,680	2,730	1,830
11	2,350	2,510	1,360	1,740	1,360	1,510	11,100	4,190	3,680	3,830	2,740	1,740
12	3,000	2,040	1,580	1,770	1,600	1,730	10,400	4,260	3,880	3,680	2,540	2,420
13	2,990	2,430	1,690	2,080	1,660	1,790	10,200	4,220	3,850	3,640	2,700	1,800
14	2,900	1,900	1,360	1,290	1,640	1,750	8,760	4,150	3,960	3,760	2,680	2,100
15	2,360	1,210	1,510	1,680	1,680	1,730	6,600	3,910	3,930	3,030	2,700	2,120
16	2,970	1,660	1,540	1,680	1,700	1,730	12,500	3,940	3,840	3,510	2,630	1,930
17	2,630	1,890	1,490	1,630	1,940	1,890	8,530	4,050	2,540	3,750	2,503	2,170
18	2,870	2,890	1,640	2,040	1,450	1,450	6,810	3,840	3,680	3,760	2,450	2,530
19	3,310	1,690	1,700	1,570	1,710	1,680	6,940	3,640	3,900	3,780	2,380	2,700
20	2,960	2,420	1,730	1,920	1,700	1,800	7,460	2,590	4,070	3,690	2,230	2,640
21	3.320	2,940	1,660	1,320	1,760	1,840	8,200	4,170	3,870	3,750	2,430	2,650
22	2,510	2,290	1,510	1,600	1,690	1,940	7,260	4,080	3,950	3,660	2,250	2,580
23	3,450	2,300	2,300	1,660	1,660	2,220	8,240	4,230	3,240	5,820	2,150	2,280
24	3,580	2,230	1,780	1,670	1,940	2,620	8,700	3,890	2,480	3,870	2,150	2,590
25	3,140	3,240	1,220	1,620	1,530	1,920	8,860	3,840	3,380	4,210	2,190	2,760
26	3,040	1,390	1,690	1,500	1,650	2,450	8,640	3.760	3,020	3,920	2,210	2,480
27	3,140	1,140	1,650	2,000	1,660	2,720	7,780	2,440	3,600	3,920	2,220	2,380
28	3,180	2,030	1,740	1,280	1,690	3,080	8,550	2,670	3,620	3,860	1,990	2,510
29	2,710	2,620	1,720	2,020	....	3,170	6,650	3,700	3,400	3,140	2,070	2,350
30	3,380	2,240	2,320	1,660	....	3,560	8,000	2,480	3,350	3,790	2,080	2,120
31	3,240	....	1,780	1,720	....	5,220	....	3,640	....	4,000	2,100	....

Monthly discharge of St. Croix River near St. Croix Falls, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 5,930 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	3,710	2,350	2,970	0.501	0.58
November	3,730	1,140	2,360	.398	.44
December	3,040	1,220	1,870	.315	.36
January	2,150	1,120	1,680	.283	.33
February	2,090	1,360	1,670	.282	.29
March	5,220	1,350	2,110	.356	.41
April	17,700	6,600	9,730	1.64	1.83
May	8,780	2,440	4,720	.796	.92
June	4,070	2,480	3,540	.597	.67
July	5,820	2,380	3,580	.604	.70
August	4,090	1,990	2,530	.427	.49
September	2,760	1,710	2,230	.376	.42
The year	17,700	1,120	3,250	.548	7.44

NOTE.—Monthly and yearly discharge computed by engineers of the U. S. Geological Survey from records of daily discharge furnished by the Minneapolis General Electric Co.

NAMAKAGON RIVER AT TREGO, WIS.

LOCATION.—In sec. 35, T. 40 N., R. 12 W., at Chicago & Northwestern Railway bridge at Trego, Washburn County, about 20 miles above confluence of Namakagon and Totogatic rivers.

DRAINAGE AREA.—420 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale: 1 inch=6 miles).

RECORDS AVAILABLE.—March 11, 1914, to September 30, 1917.

GAGE.—Enameled staff fastened to retaining wall, left bank of river, just above railroad bridge; read by G. E. Krenz.

DISCHARGE MEASUREMENTS.—Made from lower chords of railroad bridge.

CHANNEL AND CONTROL.—Bed composed of coarse gravel; free from vegetation. Banks medium high and not subject to overflow. Small island downstream, with rapids on either side, forms the control; channel fairly permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.3 feet April 4 (discharge, 803 second-feet); minimum discharge estimated, 235 second-feet December 19.

1914–1917: Maximum stage recorded, 3.0 feet April 23, 1916 (discharge, 1,330 second-feet); minimum discharge estimated, 235 second-feet December 19, 1916.

ACCURACY.—Stage-discharge relation permanent, except for ice effect. Rating curve well defined between 330 and 1,330 second-feet; extended below 330 second-feet by estimation. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except for period in which stage-discharge relation was affected by ice, for which it was obtained by applying to rating table daily gage heights corrected for ice effect by means of discharge measurements, observer's notes, and weather records. Open-water records good; winter records fair.

Discharge measurements of Namakagon River at Trego, Wis., during the year ending Sept. 30, 1917.

[Made by R. B. Kilgore.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Jan. 8 [a]	2.21	273	Mar. 8 [a]	2.83	337
Feb. 3 [a]	2.70	334	Aug. 17	1.65	398

[a] Complete ice cover at control section.

Daily discharge, in second-feet, of Namakagon River at Trego, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	564	472	472	280	300	280	488	733	472	472	393	350
2	332	444	472	280	320	290	444	733	502	444	393	332
3	350	472	472	290	330	305	624	698	502	472	369	320
4	369	472	458	300	320	300	803	664	532	472	369	369
5	532	472	444	290	300	295	786	698	532	472	369	417
6	564	393	430	290	290	300	768	733	502	532	369	350
7	502	393	417	280	290	300	786	698	564	597	393	350
8	472	472	430	270	290	325	803	664	597	532	472	332
9	369	472	444	290	290	320	768	614	564	472	444	393
10	472	417	388	310	300	315	733	564	502	532	444	369
11	472	393	332	310	300	310	750	548	502	564	417	350
12	472	369	310	300	280	310	768	532	472	597	393	332
13	502	369	290	290	270	305	682	532	472	597	393	369
14	472	350	270	280	280	330	597	532	472	564	417	369
15	472	330	260	270	290	350	597	532	472	502	369	350
16	472	350	250	260	280	340	597	502	472	472	393	332
17	532	370	245	280	280	330	648	502	472	502	369	332
18	532	395	240	300	270	340	698	472	417	444	369	320
19	532	417	235	300	260	350	733	472	502	444	369	332
20	502	474	240	300	260	330	768	472	502	472	332	332
21	532	532	245	280	270	330	786	472	532	564	369	332
22	502	502	245	260	280	340	803	472	502	532	393	320
23	393	472	250	260	290	350	768	472	532	564	369	320
24	417	402	250	255	290	360	733	472	532	472	369	320
25	502	332	255	280	280	370	716	472	532	472	393	332
26	472	362	255	310	290	395	698	444	597	417	320	332
27	472	393	300	280	300	417	698	444	532	417	320	350
28	472	462	300	260	300	430	698	393	564	444	369	350
29	417	532	310	290	....	444	716	417	532	417	393	332
30	393	502	290	310	....	488	733	472	502	393	369	332
31	472	....	280	300	....	532	....	502	....	369	393	....

NOTE.—Stage-discharge relation affected by ice Nov. 14-18 and Dec. 12 to Mar. 26. Gage read every other day Nov. 20 to May 11; discharge for intervening days estimated.

Monthly discharge of Namakagon River at Trego, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 420 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	564	332	469	1.12	1.29
November	532	330	426	1.01	1.13
December	472	235	325	.774	.89
January	310	255	286	.681	.79
February	330	260	289	.688	.72
March	532	280	348	.829	.96
April	803	444	706	1.68	1.87
May	733	393	546	1.30	1.50
June	597	417	513	1.22	1.36
July	597	369	491	1.17	1.35
August	472	320	384	.914	1.05
September	417	320	344	.819	.91
The year	803	235	428	1.02	13.82

KETTLE RIVER NEAR SANDSTONE, MINN.

LOCATION.—Near south line of sec. 34, T. 43 N., R. 20 W., at quarries of Barber Asphalt Co. at Banning, 3 miles above Sandstone, Pine County.

DRAINAGE AREA.—825 square miles.

RECORDS AVAILABLE.—October 18, 1908, to December 7, 1916, when station was discontinued.

GAGE.—Vertical staff in two sections, bolted to rock wall on right bank of river, about 300 feet above the steam power house of the Barber Asphalt Co.; read by F. L. Betts.

DISCHARGE MEASUREMENTS.—Made from highway bridge about a mile above gage.

EXTREMES OF DISCHARGE.—1908–1916: Maximum stage recorded, 7.7 feet, April 24, 1916 (discharge, 10,600 second-feet); minimum stage recorded, 0.7 foot, November 30, 1912 (discharge about 12 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; not, however, for so long a period as at most gaging stations in the same latitude, owing to the fact that a decided rapids about 50 feet below the gage constitutes the control. The published records of winter discharge to which the open-channel rating curve is not applicable, have been based on gage readings and a comparison of the records with those for Snake River.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined from 52 to 5,940 second-feet; above 5,940 second-feet it is an extension. Gage read daily to quarter-tenths. Daily discharge ascertained by applying daily gage height to rating table. Records good.

Daily discharge, in second-feet, of Kettle River near Sandstone, Minn., for the period Oct. 1 to Dec. 7, 1917.

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1	201	250	173	11	186	186	......	21	216	112	......
2	201	233	186	12	186	186	......	22	216	124	......
3	186	233	186	13	201	173	......	23	201	136	......
4	186	233	186	14	201	173	......	24	201	136	......
5	186	233	186	15	201	160	......	25	201	136	......
6	173	233	186	16	201	148	......	26	216	136	......
7	173	216	186	17	216	136	......	27	233	148	......
8	160	216	......	18	216	124	......	28	233	148	......
9	173	216	......	19	250	124	......	29	233	160	......
10	173	201	......	20	216	112	......	30	250	173	......
								31	250	......	......

Monthly discharge of Kettle River near Sandstone, Minn., for the period Oct. 1, to Dec. 7, 1916.

[Drainage area, 825 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	250	160	204	0.247	0.29
November	250	112	173	.210	.23
December 1-7	186	173	184	.223	.06

SNAKE RIVER NEAR PINE CITY, MINN.

LOCATION.—In sec. 26 T. 39 N., R. 21 W., at Changwatana power station of Eastern Minnesota Power Co., 600 feet below dam belonging to that company, 3,500 feet below Cross Lake, 2 miles below Pine City, and about 11 miles above the mouth, in Pine County.

DRAINAGE AREA.—915 square miles.

RECORDS AVAILABLE.—June 26, 1913, to September 30, 1917, when station was discontinued.

GAGE.—Staff gage attached to stone retaining wall in front of the power plant on the left bank of the river; read by E. W. Barnum, and other employees of the Eastern Minnesota Power Co. This gage is used for determining the flow over the dam during periods when all of the flow does not pass through the turbines.

DISCHARGE MEASUREMENTS.—Made by wading or from bridge about 1,800 feet above the gage.

CHANNEL AND CONTROL.—Bed of stream rock and heavy gravel; banks in vicinity of gage high and not likely to be overflowed. Zero flow at stage 0.2 foot.

DETERMINATION OF FLOW.—Flow determined by adding to the flow through the turbines the flow over the crest of the dam as obtained from readings of the staff gage. The flow through the turbines is computed from hourly records of the gate openings and head.

Extremes of discharge.—Maximum daily discharge, 4,580 second-feet, April 6; minimum daily discharge, 59 second-feet, January 28 and March 4.

1913–1917: Maximum discharge 7,315 second-feet, April 25, 1916; minimum discharge 33 second-feet, February 11, 1914.

Winter flow.—All water goes through the wheels in winter; flow estimated from gate openings and head.

Regulation.—Power plant at the station is operated with a varying load for light and power, causing daily and weekly fluctuations in discharge at low stages. No appreciable regulation above plant.

Accuracy.—When the flow is about 200 second-feet or less, the greater part of it passes through the power plant and is estimated from turbine gate openings and head on the wheels, an hourly record of which is kept at the plant. The results of this determination can be considered only fair. As the volume of flow increases a larger portion passes by the plant as waste, at very high stages by far the greater part of the discharge is waste; this part of the discharge is determined from gage heights read from a gage in the river opposite the power plant. Stage-discharge relation for river gage permanent. Rating curve well defined throughout. Gage read to hundredths every four hours. Daily discharge ascertained by applying each gage height to the rating table, and taking the mean of the six determinations of discharge. Records of total flow at the station range from fair for low stages to excellent for high stages.

Cooperation.—The hourly records of gate openings of the turbines and head, and reading of the river gage are furnished by the Eastern Minnesota Power Co. Records for last part of current year computed by the employees of the company by use of rating curves prepared by the engineers of the Survey.

Daily discharge, in second-feet, of Snake River near Pine City, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	203	264	128	81	71	75	547	1,230	293	93	162	76
2	279	258	138	81	71	76	1,120	1,460	306	174	137	86
3	286	262	94	81	69	74	1,860	1,170	199	176	133	76
4	273	267	137	81	64	59	2,700	1,160	270	96	159	78
5	291	234	139	81	67	77	3,920	1,070	284	211	115	82
6	273	248	136	82	69	76	4,580	1,050	287	335	144	98
7	243	260	139	73	69	77	4,440	968	290	253	172	96
8	181	251	139	83	69	78	4,190	922	288	100	167	77
9	258	249	140	79	70	78	3,770	799	262	271	152	98
10	260	241	99	79	69	78	3,330	750	175	358	142	96
11	254	245	126	76	60	64	2,910	686	257	370	163	82
12	250	132	135	76	70	83	2,520	587	303	395	123	105
13	247	212	137	76	70	77	2,210	533	291	382	194	119
14	246	239	129	70	70	76	1,940	545	283	360	167	121
15	125	235	127	76	71	78	1,690	471	260	297	157	124
16	226	229	128	76	71	78	1,490	449	234	339	157	85
17	243	169	100	77	72	79	1,250	398	115	269	160	138
18	231	138	116	75	62	70	1,220	351	188	225	155	139
19	245	99	118	74	73	83	1,100	412	212	207	121	138
20	242	132	115	69	73	79	1,080	309	212	232	142	138
21	243	143	104	64	73	81	1,120	364	202	231	145	138
22	216	144	102	70	73	79	1,180	360	184	163	139	138
23	234	144	100	70	75	89	1,340	359	195	251	147	113
24	235	146	87	70	72	96	1,410	364	114	242	131	130
25	243	143	97	71	64	76	1,450	304	200	240	134	127
26	224	97	99	71	76	96	1,480	254	202	215	113	120
27	227	131	96	71	76	109	1,400	137	190	191	133	120
28	231	138	97	59	75	117	1,300	241	178	200	125	118
29	133	139	96	71	....	133	1,260	247	168	111	119	117
30	229	105	95	71	....	108	1,230	160	173	186	108	101
31	268	....	73	71	....	388	....	271	....	185	101	....

Monthly discharge of Snake River near Pine City, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 915 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	291	125	237	0.259	0.30
November	267	97	190	.208	.23
December	140	73	115	.126	.15
January	83	59	74.3	.081	.09
February	76	60	70.1	.077	.08
March	388	59	96.0	.105	.12
April	4,580	547	2,040	2.23	2.49
May	1,460	137	593	.648	.75
June	306	114	227	.248	.28
July	395	93	237	.259	.30
August	194	101	142	.155	.18
September	139	76	109	.119	.13
The year	4,580	59	343	.376	5.10

APPLE RIVER NEAR SOMERSET, WIS.

LOCATION.—In sec. 21, T. 31 N., R. 19 W., St. Croix County, at power plant of St. Croix Power Co., 3½ miles below Somerset and 2 miles above mouth of river.

DRAINAGE AREA.—550 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale: 1 inch=6 miles).

RECORDS AVAILABLE.—January 1901, to September 30, 1917.

GAGE.—Vertical staff gage; readings not used in determination of flow.

DISCHARGE.—The discharge of the turbines in second-feet corresponding to the number of kilowatts is determined for each hour during the day from a record of the number of wheels in operation and the load; the sum of the discharge divided by 24 gives the average discharge through the turbines. To this quantity is added the leakage through the average number of wheels idle each day, the sum giving the daily flow through the power house. Water is seldom wasted over the spillway of the dam, but when it is so wasted the quantity is computed from weir formulas and added to the flow through the plant. There is a constant leakage through the gate and flashboards amounting to 3 second-feet. This quantity has not been taken into consideration in computing the published records.

EXTREMES OF DISCHARGE.—Maximum daily discharge during year, 966 second-feet, April 6; minimum daily discharge, 62 second-feet October 26.

1904–1917: Maximum daily discharge, 2,280 second-feet in June, 1905; minimum daily discharge, 38 second-feet May 10, 1910. Minimum discharge caused by regulation. Records of maximum and minimum discharge, 1901–1903, not available.

REGULATION.—There are a number of power plants on Apple River above the station. The pondage of these plants is small, and though the daily flow may be controlled to some extent the mean monthly flow probably corresponds closely to the natural flow.

ACCURACY.—In June, 1914, a series of current-meter measurements were made by the Wisconsin Railroad Commission and United States Geological Survey, and a rating curve for the tailrace was developed. Twelve tests were then run with different wheels and loads. It was found that the discharge as determined by the current meter and the discharge as computed by the company agreed very closely, the percentage difference for the 12 tests ranging from −6.4 per cent to +1.8 per cent, with an average of −2.0 per cent; the discharge as determined by the company being 2 per cent less than that determined by the current meter.

COOPERATION.—Records furnished by the St. Paul Gas Light Co., of St. Paul, Minn., F. L. Cross, general manager.

No discharge measurements were made at this station during the year.

Daily discharge, in second-feet, of Apple River near Somerset, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	136	216	292	195	211	262	741	547	351	339	261	229
2	234	265	234	258	219	230	910	510	524	324	259	127
3	211	278	216	259	200	253	893	487	492	283	187	175
4	303	231	294	265	233	172	913	459	519	280	247	181
5	278	81	329	275	201	267	944	388	479	300	138	166
6	238	292	277	256	269	264	966	222	398	314	181	202
7	252	214	275	134	277	252	896	343	333	350	217	168
8	245	265	278	261	161	246	885	459	301	192	169	200
9	235	296	319	215	229	271	865	470	365	320	204	186
10	265	275	138	201	245	298	831	377	401	319	166	169
11	254	266	223	202	197	254	799	352	418	321	262	126
12	290	188	185	194	221	281	759	302	355	311	150	222
13	306	255	215	235	249	284	629	311	312	293	220	162
14	296	264	153	155	252	283	578	379	289	279	241	214
15	136	255	233	212	246	290	631	349	296	255	194	245
16	232	228	206	204	257	293	679	291	303	307	204	121
17	237	265	263	235	262	272	519	312	169	306	211	193
18	186	247	242	251	146	190	348	291	236	280	260	182
19	265	195	230	253	252	292	506	266	306	312	136	188
20	274	268	264	233	254	304	652	169	297	314	200	184
21	265	278	245	205	247	295	658	279	344	359	195	290
22	62	274	243	213	159	300	462	263	258	240	205	252
23	291	296	275	220	264	317	338	204	341	316	206	151
24	215	247	171	230	223	579	489	209	237	290	202	206
25	249	273	203	257	192	437	555	277	299	276	227	236
26	276	151	272	252	257	397	625	282	456	296	213	210
27	250	363	224	223	223	471	431	163	373	232	286	197
28	315	250	237	216	244	534	367	256	367	269	253	210
29	68	319	209	237	....	599	472	300	295	128	204	256
30	301	153	242	218	....	575	691	217	339	274	106	147
31	247	....	234	202	....	736	....	326	....	313	196	....

NOTE.—See note under "Discharge" in station description for account of method by which these records were obtained.

Monthly discharge of Apple River near Somerset, Wis., for the year ending Sept. 30, 1917

[Drainage area, 550 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	315	62	239	0.435	0.50
November	363	81	248	.451	.50
December	329	138	239	.435	.50
January	275	134	225	.409	.47
February	277	146	228	.415	.43
March	736	172	339	.616	.71
April	966	338	668	1.21	1.35
May	547	163	325	.591	.68
June	524	169	348	.633	.71
July	359	128	290	.527	.61
August	286	106	206	.375	.43
September	290	121	193	.351	.39
The year	966	62	296	.538	7.28

KINNIKINNIC RIVER NEAR RIVER FALLS, WIS.

Location.—In sec. 18, T. 27 N., R. 19 W., at Clifton Hollow Bridge, a quarter of a mile downstream from dam of Clifton Falls Power Co., 2 miles above mouth of river and 7 miles downstream from River Falls, Pierce County.

Drainage area.—170 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale: 1 inch=6 miles).

Records available.—October 23, 1916, to September 30, 1917.

Gage.—Gurley graph water-stage recorder, in a wooden well fastened to downstream side of right-hand cushing bridge pier.

Discharge measurements.—Made from bridge or by wading.

Channel and control.—Bed composed of rather heavy gravel and sand; control is head of small rapids 150 feet below the gage. High water will wash out and fill in this control section, causing small changes.

Extremes of discharge.—Maximum stage recorded during year, 5.66 feet 4.30 p. m. March 27 (discharge, about 1,900 second-feet); minimum stage recorded, 1.7 feet (discharge, about 15 second-feet), occurred several times following complete shutdown. The maximum is about the natural maximum; minimum caused by regulation at the power house.

Ice.—Stage-discharge relation affected to some extent by ice.

Regulation.—The daily flow is regulated almost completely by the Clifton power dam just above the station. There are three dams in River Falls which may also have some effect on the daily flow. The storage at these dams is, however, relatively small, and the monthly flow is considered to be nearly the normal flow.

Accuracy.—Stage-discharge relation not permanent. Three rating curves used as follows: October 22 to March 25, well defined between 0 and 120 second-feet; March 26 to July 18, fairly well defined between 15 and 400 second-feet, extended and subject to error above and below these limits; July 19 to September 30, 1917, poorly defined throughout. Continuous gage record obtained by recording gage, except during a portion of January and February, when gage well was frozen. Daily discharge ascertained by means of discharge integrator, except during last part of January and February, when it was estimated. Open-water records good, except those for high water, which are fair; winter records subject to some error.

Discharge measurements of Kinnikinnic River near River Falls, Wis., during the years ending Sept. 30, 1916 and 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1916.		*Feet.*	*Sec.-ft.*	1916–17.		*Feet.*	*Sec.-ft.*
Sept. 21	W. G. Hoyt	2.39	70	Feb. 15	R. B. Kilgore	2.53	86
1916–17.				Apr. 4	.....do	2.36	78
Oct. 18	R. B. Kilgore	2.44	68	June 4	.....do	3.38	344
22	.....do	1.88	15	4	.....do	1.90	22
Dec. 4	.....do	2.40	67	4	.....do	1.89	20
Jan. 16	.....do	2.50	84	Aug. 9	.....do	1.82	18
				9	.....do	3.24	358

Daily discharge, in second-feet, of Kinnikinnic River near River Falls, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	....	61	57	80	65	53	331	67	85	50	89	60
2	....	62	81	104	65	45	195	65	73	108	62	81
3	....	61	35	102	65	51	126	66	76	76	56	49
4	....	72	79	97	65	66	132	64	156	72	74	74
5	....	54	54	94	65	67	106	69	117	133	57	91
6	....	92	54	82	65	82	104	44	97	124	53	74
7	....	70	78	33	65	112	89	79	78	93	79	68
8	....	59	47	54	65	76	66	74	78	96	72	79
9	....	80	56	57	65	75	82	55	82	160	63	76
10	....	57	49	51	65	96	74	68	86	112	52	74
11	....	86	83	53	65	64	76	63	83	167	80	56
12	....	39	63	61	65	78	65	73	88	138	80	74
13	....	72	61	60	65	86	60	46	49	84	66	79
14	....	40	53	53	65	66	69	59	102	92	66	88
15	....	53	60	72	67	68	60	66	96	73	72	73
16	....	62	74	73	67	82	79	58	64	140	58	76
17	....	71	60	71	89	71	72	60	108	107	60	80
18	....	64	80	71	60	62	62	63	160	90	57	76
19	....	48	102	70	60	96	68	78	54	85	44	83
20	....	69	74	65	60	82	68	84	94	78	81	87
21	....	57	79	78	60	64	76	58	61	66	67	74
22	....	59	77	69	60	103	64	84	78	78	72	62
23	61	77	84	68	60	58	72	59	89	78	63	46
24	63	60	75	65	60	128	75	61	210	76	56	86
25	85	62	65	69	40	375	76	53	361	74	65	62
26	54	47	124	66	62	908	74	95	232	74	58	78
27	56	73	82	65	63	1,300	62	61	132	74	68	80
28	56	57	76	65	64	1,110	74	73	114	69	70	75
29	55	62	87	65	....	1,030	63	104	126	83	64	75
30	95	48	88	65	....	920	80	108	48	68	67	70
31	61	....	123	65	....	938	....	84	....	62	70	....

NOTE.—Gage well frozen Jan. 27 to Feb. 28; discharge estimated. Discharge determined from gage-height record for less than the 24-hour period, Oct. 28, 29, Nov. 15–17, Dec. 23–24, 30, 31, Jan. 6, 7, 13, 14, 21–26, June 9, and Sept. 28–29.

Monthly discharge of Kinnikinnic River near River Falls, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 170 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October 23–31	....	....	65.1	0.383	0.13
November	92	39	62.5	.368	.41
December	124	35	72.9	.429	.49
January	104	33	69.1	.406	.47
February	....	....	63.6	.374	.39
March	1,300	45	271	1.59	1.83
April	331	60	90.0	.529	.59
May	108	44	69.1	.406	.47
June	361	48	109	.641	.72
July	167	50	92.9	.546	.63
August	89	44	66.2	.389	.45
September	91	46	73.5	.432	.48

CHIPPEWA RIVER AT BISHOP'S BRIDGE, NEAR WINTER, WIS.

Location.—In sec. 23, T. 39 N., R. 6 W., at highway bridge 3 miles downstream from East Fork of Chippewa River (coming in from the left) and 4 miles by road northwest of Winter, Sawyer County.

Drainage area.—775 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

Records available.—February 23, 1912, to September 30, 1917.

Gage.—Chain gage fastened to highway bridge used since May 23, 1916; read by John Edburg. Gages previously used as follows: February 23, 1912, to January 27, 1914, a wooden staff gage fastened to a wooden pier on right bank just above bridge; datum 3.44 feet above that for chain gage; January 27, 1914, to May 28, 1916, a vertical cast-iron staff gage fastened to same pier; datum same as for chain gage.

Discharge measurements.—Made from downstream side of highway bridge.

Channel and control.—Bed composed of gravel; free from vegetation and not subject to shift. Control is at head of rapids about 1,000 feet below gage; practically permanent. One channel at all stages. Banks not subject to overflow.

Extremes of discharge.—Maximum stage recorded during year, 7.23 feet at 9 a. m. April 22 (discharge, 3,020 second-feet); minimum discharge estimated at 175 second-feet February 17.

1913–1917: Maximum stage recorded, 9.56 feet April 22, 1916 (discharge, 6,940 second-feet); minimum discharge (estimated) February 17, 1917.

Regulation.—Flow modified to some extent by operation of storage reservoir in sec. 14, T. 41 N., R. 6 W., about 16 miles above station. Reservoir has a capacity of 550,000,000 cubic feet and is used in connection with reservoirs on upper Flambeau River for regulating flow of Chippewa River.

Accuracy.—Stage-discharge relation permanent except as effected by ice during winter period and by logs during a portion of April and May. Rating curve well defined between 270 and 6,820 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except for period in which stage-discharge relation was affected by ice, for which it was obtained by applying to the rating table daily gage height corrected for ice effect by means of discharge measurements, observer's notes, and weather records; discharge for periods of April and May, when logs were present, interpolated. Open-water records excellent except those for April and May which are fair; winter records good.

Discharge measurements of Chippewa River at Bishop's Bridge, near Winter, Wis., during the year ending Sept. 30, 1917.

[Made by R. B. Kilgore.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Oct. 24	5.36	883	Mar. 9[a]	6.01	233
Jan. 5[a]	5.36	269	Aug. 14	4.45	309
Feb. 5[a]	5.53	211			

[a] Complete ice cover.

Daily discharge, in second-feet, of Chippewa River at Bishop's Bridge, near Winter, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	750	710	405	340	230	210	590	2,440	915	1,200	360	340
2	710	675	530	320	225	210	630	2,540	1,000	1,000	340	322
3	675	675	405	305	210	210	635	2,640	1,000	915	322	304
4	610	640	405	285	210	210	690	2,740	1,100	915	322	304
5	580	640	405	270	210	210	675	2,840	1,400	830	322	304
6	555	640	505	260	210	205	680	2,700	1,520	1,150	322	304
7	530	675	405	255	210	215	675	2,270	1,740	1,400	322	304
8	505	710	405	255	210	225	800	1,830	1,620	1,400	340	304
9	555	710	322	255	210	230	830	1,400	1,520	1,400	340	304
10	555	750	285	250	210	240	830	1,350	1,520	1,350	360	304
11	530	750	270	240	200	255	915	1,400	1,520	1,350	360	304
12	530	750	255	240	195	265	1,000	1,290	1,400	1,300	360	340
13	675	750	255	240	190	265	1,050	1,190	1,200	1,100	340	360
14	790	790	240	225	180	320	1,100	1,080	1,100	960	322	430
15	870	750	240	210	190	330	1,150	975	1,000	870	304	430
16	1,000	750	240	210	195	350	1,250	870	915	790	304	430
17	1,100	610	240	210	175	380	1,200	870	790	675	304	430
18	1,150	640	240	210	195	390	1,300	1,050	710	610	304	455
19	1,100	580	240	210	210	430	1,400	1,150	710	580	304	480
20	1,100	555	240	220	210	435	1,960	1,100	790	640	287	480
21	1,000	530	255	225	225	435	2,520	1,050	750	675	287	455
22	1,000	505	285	230	225	440	2,980	1,050	750	675	270	430
23	915	480	340	240	210	485	2,840	1,000	870	610	287	380
24	830	405	360	240	210	485	2,700	960	1,050	555	287	360
25	830	405	380	240	210	495	2,840	915	1,200	530	287	360
26	790	405	380	280	225	510	2,700	830	1,400	505	304	360
27	790	405	380	225	210	530	2,440	790	1,300	480	304	360
28	750	430	380	225	225	535	2,180	580	1,350	430	287	360
29	710	430	360	225	....	565	2,240	304	1,350	405	304	380
30	710	455	340	230	....	590	2,310	530	1,350	380	322	380
31	710	....	340	240	....	580	....	790	....	380	322	....

NOTE.—Stage-discharge relation affected by ice Nov. 25–28 and Dec. 10 to Apr. 9; discharge interpolated, because of logs on control, Apr. 11, 18, 20, 21, 23, 29, May 2–4, 7, 8, and 12–15.

Monthly discharge of Chippewa River at Bishop's Bridge, near Winter, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 775 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,150	505	771	0.995	1.15
November	790	405	607	.783	.87
December	530	240	333	.430	.50
January	340	210	244	.315	.36
February	230	175	208	.268	.28
March	590	205	362	.467	.54
April	2,980	590	1,500	1.94	2.16
May	2,840	304	1,370	1.77	2.04
June	1,740	710	1,160	1.50	1.67
July	1,400	380	841	1.09	1.26
August	360	270	316	.408	.47
September	480	304	369	.476	.53
The year	2,980	175	675	.871	11.83

CHIPPEWA RIVER NEAR BRUCE, WIS.

LOCATION.—In sec. 4, T. 35 N., R. 7 W., at Minneapolis, St. Paul & Sault Ste. Marie Railway bridge 1 mile east of Bruce, Rush County. Thornapple River enters from the left immediately above the station, and Flambeau River from the left about 21 miles below.

DRAINAGE AREA.—1,600 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—December 31, 1913, to September 30, 1917.

GAGE.—Chain gage, attached to downstream side of Minneapolis, St. Paul & Sault Ste. Marie Railway bridge; read by H. C. Gardner.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of sand and small gravel; free from vegetation; first and second channels from the west fairly permanent; third channel nearest east bank has a tendency to fill during low stages with sand worked in by Thornapple River. Flow except during extreme high stages is confined within the banks.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.05 feet April 21 (discharge, 7,060 second-feet); minimum discharge estimated 310 second-feet during January and February.

1910–1917: Maximum stage recorded: 12.3 feet at 5.45 p. m., April 22, 1916 (discharge 13,400 second-feet); minimum discharge, about 310 second-feet during January and February, 1917

ICE.—Stage-discharge relation affected by ice.

REGULATION.—Flow modified to some extent by reservoir on the West Fork of Chippewa River, in sec. 14, T. 41 N., R. 6 W. Reservoir has a capacity of 550,000,000 cubic feet, and is used in connection with reservoirs on upper Flambeau River for the purpose of regulating the flow of Chippewa River. No diurnal fluctuation is observed.

ACCURACY.—Stage-discharge relation not permanent; affected by ice during winter periods and changes caused by shifting control during periods of low water. Rating curves poorly defined. Gage read to quarter tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except for the period in which stage-discharge relation was affected by ice, for which periods it was obtained by applying to rating table mean daily gage height corrected for ice effect by means of discharge measurements, observer's notes, and weather records. Open-water records fair; winter records subject to error.

Discharge measurements of Chippewa River near Bruce, Wis., during the year ending Sept. 30, 1917.

Date.	Made by-	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 26	R. B. Kilgore	2.76	1,310	Mar. 12[a]	R. B. Kilgore	3.68	406
Jan. 9[a]	E. L. Williams	3.06	426	May 14	do	3.40	1,800
Feb. 7[a]	R. B. Kilgore	3.25	392	Aug. 15	do	1.33	313

[a] Complete ice cover.

Daily discharge, in second-feet, of Chippewa River near Bruce, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,230	1,140	1,060	650	310	340	1,040	4,840	3,400	1,800	575	430
2	1,140	1,140	1,050	615	310	360	1,440	4,600	3,100	1,600	690	380
3	1,050	1,050	970	580	310	390	1,830	4,300	2,600	1,400	430	480
4	1,010	1,050	890	545	340	390	2,060	3,900	2,500	1,200	540	380
5	970	1,060	890	510	370	385	2,290	3,600	2,600	1,200	510	540
6	890	1,010	890	510	390	380	2,970	3,300	2,900	1,800	405	380
7	890	1,010	930	475	405	370	3,980	3,100	4,200	3,100	510	540
8	850	1,230	890	440	390	405	3,980	3,000	4,200	3,200	540	326
9	850	1,520	850	425	370	440	3,870	2,600	4,000	2,800	480	575
10	890	1,720	810	410	370	420	3,900	2,500	3,000	2,400	610	455
11	890	1,520	810	400	370	405	4,840	2,300	2,600	2,300	510	405
12	930	1,520	770	390	370	405	5,200	2,200	2,400	2,200	690	430
13	970	1,320	730	380	370	405	4,300	2,100	2,300	2,100	610	455
14	1,230	690	690	370	355	450	4,000	2,000	2,000	1,800	540	510
15	1,320	615	650	365	340	495	3,400	1,900	1,700	1,600	326	610
16	1,420	1,520	615	360	355	520	3,100	1,600	1,500	1,400	575	340
17	1,720	1,420	580	355	370	545	3,100	1,800	1,400	1,100	310	610
18	1,720	1,320	580	350	355	600	3,400	1,700	1,200	1,100	480	610
19	1,720	1,230	545	340	340	650	4,400	1,800	1,100	890	480	455
20	1,720	1,230	510	330	355	690	5,680	1,800	690	1,060	455	540
21	1,620	1,140	475	320	370	730	7,000	1,900	1,300	1,500	430	540
22	1,520	1,050	440	310	390	750	6,760	1,800	1,400	1,300	430	510
23	1,520	1,050	440	310	405	770	5,800	1,500	890	1,200	430	480
24	1,320	970	440	310	390	790	4,840	1,600	810	1,200	455	810
25	1,320	970	440	310	370	810	4,300	1,500	1,900	930	282	510
26	1,320	970	475	310	370	830	4,000	1,100	2,100	930	650	350
27	1,320	1,050	510	310	370	850	4,000	1,020	2,100	610	326	575
28	1,230	1,050	580	310	355	870	4,000	1,020	1,700	890	455	510
29	1,230	1,050	615	310	....	890	4,100	1,020	2,000	930	380	510
30	1,140	1,050	650	310	....	950	4,600	1,060	1,800	610	370	510
31	1,140	....	650	310	....	1,010	....	2,200	....	610	480	....

NOTE.—Stage-discharge relation affected by ice Nov. 16 to Dec. 1 and Dec. 9 to April 10.

Monthly discharge of Chippewa River near Bruce, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 1,600 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,720	850	1,230	0.769	0.89
November	1,720	615	1,160	.725	.81
December	1,050	440	691	.432	.50
January	650	310	394	.246	.28
February	405	310	363	.227	.24
March	1,010	340	590	.369	.43
April	7,000	1,040	3,940	2.46	2.74
May	4,840	1,020	2,280	1.42	1.64
June	4,200	690	2,180	1.36	1.52
July	3,200	610	1,510	.944	1.09
August	690	282	482	.301	.35
September	810	326	492	.308	.34
The year	7,000	282	1,280	.800	10.83

CHIPPEWA RIVER AT CHIPPEWA FALLS, WIS.

LOCATION.—In SE. ¼ sec. 6, T. 28 N., R. 8 W., at highway bridge at Chippewa Falls, Chippewa County, 2,500 feet below mouth of Duncan Creek, coming in from the right.

DRAINAGE AREA.—5,600 square miles.

Records available.—June 22, 1888, to September 30, 1917. The gage was originally established by the Chippewa Lumber & Boom Co., which has kept a continuous record since 1889. Since 1904 the United States Weather Bureau has obtained gage readings during the flood season of each year. On June 1, 1906, the United States Geological Survey began making discharge measurements and maintaining gage readings.

Gage.—On July 27, 1916, a Gurley graph water-stage recorder replaced Friez water-stage recorder which was installed January, 1914, on web between cushing piers supporting first right-hand span and about 10 feet upstream from the gage formerly used by United States Weather Bureau; gage referred to the original datum.

Discharge measurements.—Made from downstream side of bridge or by wading.

Channel and control.—Heavy gravel; fairly permanent; both banks high and are rarely overflowed.

Extremes of stage.—Maximum stage recorded during year, 8.32 feet at 12 a. m., April 23 (discharge 24,900 second-feet); minimum discharge estimated 40 second-feet February 4; on this date all gates and other openings in the Wissota plant of the Wisconsin & Minnesota Light & Power Co. were closed, the discharge of 40 second-feet being the inflow between the dam and the station.

1888–1917: Maximum stage recorded, 26.03 feet December 6, 1896. September 10, 1884, a stage of 26.94 feet was reached; discharge not estimated. Minimum discharge recorded February 4, 1917.

Ice.—Stage-discharge relation seriously affected by ice.

Regulation.—From October to January 15 little fluctuation was caused by the operation of power plant about half a mile above gage. Considerable fluctuation was, however, caused by the operation of larger plants above, notably the plant of the Burnett Falls Manufacturing Co., at Cornell, Wis. Beginning about January 15 operation was started at the Wissota plant of the Wisconsin & Minnesota Light & Power Co. The pond was filled during January and February and operation of the wheels was begun about February 15. After this date flow during medium and low stage is controlled by this plant.

Accuracy.—Stage-discharge relation practically permanent. Rating curve well defined between 530 and 56,200 second-feet; below 530 second-feet poorly defined. Operation of water-stage recorder was satisfactory throughout the year. Except for periods when stage-discharge relation was affected by ice, daily discharge October 1 to May 11 ascertained by applying to rating table, mean daily gage height obtained by planimeter from gage-height graph; discharge May 12 to September 30 obtained with the discharge intergrator. Discharge during periods when stage-discharge relation was affected by ice November 18–24, December 14 to April 5 ascertained by applying to rating curve mean daily gage height corrected for the effect of ice by means of discharge measurements, observer's notes, and weather records, and to some extent on computations of flow through the Wissota dam. Open-water records good; winter records roughly approximate.

Discharge measurements of Chippewa River at Chippewa Falls, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 11[a]	Kilgore and Williams	1.75	1,730	Mar. 21[a]	R. B. Kilgore	0.55	1,020
18[a]	R. B. Kilgore	.12	393	May 17	do	1.32	3,070
Feb. 20[a]	do	.62	627	Aug. 12	do	—.11	656

[a] Complete ice cover.

Daily discharge, in second-feet, of Chippewa River at Chippewa Falls, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	3,620	3,850	3,190	580	365	2,210	4,310	16,300	5,700	5,170	2,800	1,700
2	3,400	4,080	3,190	450	365	1,830	5,950	17,300	6,830	4,570	2,950	960
3	3,400	4,080	3,190	450	365	1,440	7,150	17,300	7,910	4,690	3,340	740
4	3,400	4,080	2,980	640	40	1,080	8,760	16,300	7,970	3,860	3,300	1,570
5	3,190	4,080	3,190	3,400	600	1,400	10,600	14,700	5,870	4,880	1,030	1,600
6	2,780	3,850	2,980	2,030	395	1,480	11,800	13,100	9,310	4,470	2,900	1,880
7	2,780	3,850	3,190	1,620	550	1,600	15,600	13,400	9,610	6,910	1,790	1,980
8	2,780	4,080	2,980	820	335	1,580	14,400	12,800	9,920	9,840	2,570	1,620
9	2,980	4,310	2,980	580	335	1,520	15,000	9,720	13,000	8,340	2,360	900
10	2,780	5,790	2,780	1,940	395	1,490	9,720	9,140	11,000	6,870	2,250	1,200
11	2,780	6,850	2,780	1,700	450	835	12,800	8,270	8,670	5,820	2,020	1,860
12	2,780	6,850	2,480	1,620	490	1,280	19,000	7,300	6,420	5,780	950	1,480
13	2,780	6,050	2,480	1,340	490	1,510	20,000	5,720	4,060	4,320	1,340	2,010
14	2,980	5,020	2,390	820	510	1,700	19,400	6,000	3,650	4,800	1,640	1,850
15	3,190	3,620	2,390	1,860	2,210	1,680	16,600	5,230	4,150	3,110	1,480	1,720
16	4,310	3,400	1,620	430	2,390	1,910	14,000	5,630	2,630	3,760	1,710	960
17	3,850	3,190	1,620	395	1,410	1,930	12,500	4,700	2,390	2,880	1,320	1,640
18	3,190	3,190	1,050	395	1,050	1,580	14,000	4,580	2,600	2,940	1,900	2,070
19	5,020	3,190	1,410	380	1,580	1,280	13,100	4,390	2,630	3,260	1,290	2,190
20	4,780	3,190	1,860	380	610	1,320	13,700	5,730	2,710	3,380	1,550	2,410
21	4,540	2,980	2,080	380	660	980	16,600	5,400	2,900	2,900	1,890	2,150
22	4,310	2,980	2,120	380	3,190	1,370	20,400	4,610	2,410	4,270	1,740	2,160
23	4,540	2,980	2,120	365	2,430	950	23,300	4,760	5,500	2,400	1,350	1,050
24	4,080	2,980	2,120	365	2,300	950	21,500	5,320	3,980	2,790	1,800	2,190
25	4,080	2,980	900	365	2,230	745	19,000	4,810	4,540	2,680	1,750	2,160
26	3,850	3,190	2,030	365	1,890	790	17,300	3,560	4,690	2,310	1,360	2,250
27	4,080	3,190	2,480	350	1,320	895	14,700	3,910	4,370	2,410	1,570	2,190
28	4,080	2,980	2,480	350	1,580	895	14,700	4,620	8,400	2,160	1,870	1,930
29	4,080	3,400	2,480	335	....	745	12,800	3,680	4,630	800	1,770	1,930
30	4,080	3,190	2,030	335	....	1,010	15,600	3,320	4,260	3,860	1,710	905
31	4,310	....	860	350	....	2,520	....	3,740	....	2,860	1,650	....

NOTE.—Stage-discharge relation affected by ice Nov. 18-24 and Dec. 14 to Apr. 5.

Monthly discharge of Chippewa River at Chippewa Falls, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 5,600 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	5,020	2,780	3,640	0.650	0.75
November	6,850	2,980	3,920	.700	.78
December	3,190	860	2,330	.416	.48
January	3,400	335	831	.148	.17
February	3,190	40	1,090	.195	.20
March	2,520	745	1,370	.245	.28
April	23,300	4,310	14,500	2.59	2.89
May	17,300	3,320	7,910	1.41	1.63
June	13,000	2,390	5,760	1.03	1.15
July	9,840	800	4,160	.743	.86
August	3,340	950	1,900	.339	.39
September	2,410	740	1,710	.305	.34
The year	23,300	40	4,090	.730	9.92

FLAMBEAU RIVER NEAR BUTTERNUT, WIS.

Location.—In NW. ¼ SE. ¼ sec. 33, T. 41 N., R. 1 E., Ashland County, 6 miles southeast of Butternut and 7 miles upstream from Park Falls.

Drainage area.—660 square miles (measured on map issued by Wisconsin Geological & Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

Records available.—July 30, 1914, to September 30, 1917.

Gage.—Chain gage supported by built-up cantilever attached to posts set in the right bank of the river, installed May 26, 1916; read by Miss Mathilda Schulz. Vertical staff gage at same site and datum was used from July 30, 1914, until taken out by ice in spring of 1916.

Discharge measurements.—Made from a cable 1,500 feet downstream from gage.

Channel and control.—Bed at gage composed of mud and rock. Left bank is low and subject to overflow; right bank slopes back gradually to high-water mark. At the cable site, 1,500 feet below the gage, the bed is rocky and the banks high. Control is at head of Schultz Rapids about 200 feet below cable and 1,700 feet below gage.

Extremes of discharge.—Maximum stage recorded during year, 4.02 feet April 21, and 23 (discharge, 1,400 second-feet), minimum discharge estimated 340 second-feet February 9.

1914–1917: Maximum stage recorded, 9.0 feet, April 22 and 23, 1916 (discharge, 5,430 second-feet); minimum discharge, February 9, 1917.

Regulation.—Storage reservoirs are maintained by the Chippewa & Flambeau Improvement Co. on the headwaters of the Flambeau River. Of these reservoirs, Rest Lake, in sec. 9, T. 42 N., R. 5 E., with an allowable capacity of approximately 1.5 billion cubic feet, is the largest.

Accuracy.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 356 and 3,480 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating curve except for periods in which stage-discharge relation was affected by ice, for which it was obtained by applying to rating table daily gage height corrected for ice effect by means of discharge measurements, observer's notes, and weather records. Gage not read on most Sundays part of April to July; discharge interpolated. Open-water records good; winter records fair.

Discharge measurements of Flambeau River near Butternut, Wis., during the year ending Sept. 30, 1917.

[Made by R. B. Kilgore.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Jan. 3[a]	2.78	514	Mar. 1[a]	3.15	394
29[a]	2.63	389	May 12	3.39	1,070

[a] Complete ice cover.

Daily discharge, in second-feet, of Flambeau River near Butternut, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	760	940	760	535	385	385	675	1,280	1,080	1,060	554	432
2	716	985	782	520	370	385	695	1,330	1,170	1,030	518	400
3	716	1,080	805	520	380	385	715	1,330	1,140	940	554	416
4	716	1,120	782	520	390	385	740	1,330	1,120	1,120	554	416
5	673	1,080	760	520	400	385	760	1,330	1,170	1,330	554	400
6	632	895	782	520	380	385	805	1,300	1,170	1,120	554	416
7	673	805	805	500	355	385	830	1,280	1,280	1,220	554	449
8	632	895	805	485	350	385	850	1,220	1,330	1,200	554	449
9	632	985	805	475	340	385	870	1,220	1,330	1,170	554	432
10	632	985	782	465	355	385	895	1,170	1,280	1,080	554	400
11	632	985	760	450	370	385	940	1,120	1,220	985	554	400
12	673	940	738	430	385	385	960	1,080	1,120	985	554	385
13	895	940	716	415	370	385	985	1,030	1,030	940	518	416
14	940	985	715	415	355	385	1,030	985	940	895	518	518
15	985	449	715	420	355	385	1,080	985	895	872	554	592
16	1,080	342	690	435	355	385	1,120	940	805	850	554	554
17	1,120	508	675	450	355	385	1,170	895	805	760	554	554
18	1,120	673	675	445	355	385	1,220	940	805	716	554	518
19	1,120	739	650	440	355	400	1,120	985	895	673	554	483
20	1,080	805	630	430	360	400	1,280	962	985	673	554	449
21	1,030	850	630	420	365	415	1,380	940	1,030	632	554	432
22	985	895	610	415	370	430	1,380	895	1,030	632	518	416
23	940	850	590	400	370	450	1,380	850	1,030	632	483	385
24	940	828	590	385	370	465	1,380	805	1,100	632	449	370
25	895	805	575	390	370	485	1,380	760	1,170	632	449	356
26	895	718	575	400	370	500	1,380	760	1,170	632	554	400
27	895	632	555	395	385	520	1,330	738	1,170	632	554	432
28	895	674	555	390	385	555	1,220	716	1,120	592	554	449
29	895	716	555	390	....	575	1,220	716	1,080	592	483	432
30	895	738	535	395	....	590	1,220	716	1,080	592	449	416
31	895	....	535	400	....	630	....	985	....	554	449	....

NOTE.—Stage-discharge relation affected by ice, Dec. 14 to Apr. 17. No gage-height records, Apr. 22, 29, May 6, 13, 20, 27, June 3, 10, 17, 24, July 1, 8, 15, 22, 29 and Aug. 5; dischage interpolated.

Monthly discharge of Flambeau River near Butternut, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 660 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,120	632	858	1.30	1.50
November	1,120	342	828	1.25	1.40
December	805	535	682	1.03	1.19
January	535	385	444	.673	.78
February	400	340	368	.558	.58
March	630	385	430	.651	.75
April	1,380	675	1,070	1.62	1.81
May	1,330	716	1,020	1.55	1.79
June	1,330	805	1,080	1.64	1.83
July	1,330	554	851	1.29	1.49
August	554	449	531	.805	.93
September	592	356	439	.665	.74
The year	1,380	340	718	1.09	14.79

FLAMBEAU RIVER NEAR LADYSMITH, WIS.

LOCATION.—In SE. ¼ sec. 20, T. 35 N., R. 5 W., at H. J. Cornelissen's farm, about 6 miles by road northeast of Ladysmith, Rusk County, 21 miles below mouth of South Fork of Flambeau River, coming in from the left, and 28 miles above mouth of river.

DRAINAGE AREA.—1,940 square miles (measured on map issued by Wisconsin Geological & Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—January 2, 1914, to September 30, 1917. From February 15, 1905, to December 2, 1906, records were collected at a station in the city of Ladysmith, three-fourths of a mile south of the Minneapolis, St. Paul & Sault Ste. Marie Railway station, half a mile below the dam of the Menasha Pulp Co., and about 6 miles below the present station.

GAGE.—Chain, fastened to a cantilever arm supported by two trees on the left bank of the river, on the farm of H. J. Cornelissen; read by H. J. Cornelissen.

DISCHARGE MEASUREMENTS.—Made from cable 200 feet below gage.

CHANNEL AND CONTROL.—Bed composed of gravel and sand; free from vegetation and fairly permanent. At the gage section, channel is divided by a small sandy island; at the cable section the river flows in one channel; banks are medium high, wooded, and not subject to overflow. Control not well defined, formed by the channel below the gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year when chanel was clear of ice and logs 6.6 feet June 7, 8 (discharge 7,880 second-feet); minimum discharge, 605 second-feet March 10–17.

1903–1906 and 1914–1917: Maximum discharge recorded, 17,400 second-feet April 23, 1916; minimum discharge, 390 second-feet December 4, 1904.

ICE.—Large quantities of frazil ice form on the falls and rapids above the station and fill the channel for a distance of several miles from the gage to pond of the paper company's dam at Ladysmith, seriously affecting the stage-discharge relation.

REGULATION.—The Chippewa & Flambeau Improvement Co. operates storage reservoirs on Rest Lake and smaller reservoirs on Manitowish and Turtle rivers and Bear Creek. Weekly fluctuations at the gage are caused by operation of power plants at Park Falls and storage reservoirs; no daily fluctuation has been observed.

ACCURACY.—Stage-discharge relation permanent except as affected by logs and ice. Rating curve well defined between 770 and 17,000 second-feet, roughly approximate above and below these limits. Gage read once daily to quarter tenths. Daily discharge ascertained by applying daily gage height to rating table, except for periods in which stage-discharge relation was affected by ice or logs for which discharge was obtained by applying to rating table mean daily gage heights corrected for backwater by means of discharge measurements, observers' notes and weather records. Open-water records excellent except those for April, May, and June, when logs were in river, for which they are fair; winter records fair.

Discharge measurements of Flambeau River near Ladysmith, Wis., during the year ending Sept. 30, 1917.

[Made by R. B. Kilgore.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Jan. 10 [a]	4.94	814	May 16 [b]	3.53	1,980
Feb. 8 [a]	4.55	616	Aug. 16	2.06	807
Mar. 13 [a]	4.90	607			

[a] Complete ice cover. [b] Logs in channel below gage.

Daily discharge, in second-feet, of Flambeau River near Ladysmith, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,620	1,910	1,910	880	660	620	1,340	4,310	1,910	2,510	920	920
2	1,450	1,910	1,910	880	660	620	1,450	4,480	2,900	2,390	920	805
3	1,500	1,910	1,910	880	660	620	1,560	4,480	3,040	2,510	920	880
4	1,500	1,910	1,790	880	660	620	1,560	3,970	3,180	2,390	920	685
5	1,400	1,790	1,790	835	620	620	1,670	3,800	3,800	1,910	920	920
6	1,450	1,790	1,790	835	620	620	1,790	3,800	5,600	2,390	880	770
7	1,340	1,790	1,670	835	620	620	1,910	3,800	7,880	3,180	1,000	770
8	1,230	1,910	1,670	835	620	620	2,030	3,040	7,880	3,970	920	805
9	1,280	2,270	1,620	835	620	620	2,150	3,180	6,600	3,640	1,000	770
10	1,280	2,640	1,560	815	620	605	2,270	2,900	3,640	3,180	1,000	840
11	1,230	2,640	1,500	790	620	605	2,390	2,900	4,140	2,770	1,000	685
12	1,230	2,640	1,450	790	620	605	2,510	2,900	3,480	2,390	1,000	770
13	1,340	2,390	1,400	745	620	605	2,640	2,900	2,900	2,510	960	840
14	1,790	2,330	1,340	745	620	605	2,770	2,510	2,900	2,150	840	840
15	1,910	2,270	1,280	745	620	605	2,900	2,270	2,150	1,910	840	1,000
16	2,030	2,270	1,230	745	620	605	3,040	1,910	2,150	1,790	770	1,080
17	2,270	2,210	1,230	700	620	605	3,180	1,910	1,910	1,670	805	1,160
18	2,390	2,150	1,180	700	620	620	3,480	1,910	1,790	1,560	920	1,080
19	2,390	2,090	1,120	700	620	620	4,480	1,910	1,790	1,450	920	1,040
20	2,150	2,030	1,120	700	620	660	5,400	2,270	1,910	1,500	920	1,000
21	2,150	1,910	1,120	700	620	660	6,000	2,390	2,390	1,500	920	880
22	2,150	1,790	1,070	700	620	700	6,000	2,510	2,150	1,290	960	840
23	2,030	1,670	1,020	700	620	700	5,400	2,390	2,270	1,240	960	770
24	2,030	1,670	1,020	700	620	745	4,840	2,900	2,150	1,240	960	770
25	1,910	1,730	1,020	700	620	835	4,480	2,510	2,640	1,120	880	840
26	1,670	1,910	970	660	620	880	3,800	1,790	2,640	1,160	920	805
27	1,910	2,030	970	660	620	925	3,480	1,620	4,140	1,120	920	920
28	1,790	2,030	925	660	620	1,020	3,480	1,560	4,480	1,080	740	1,000
29	1,910	2,030	925	660	......	1,070	3,640	1,450	3,040	1,120	1,200	1,040
30	1,910	1,970	925	660	......	1,120	4,140	1,620	2,770	1,120	1,040	1,000
31	1,910	......	925	660	......	1,230	......	1,620	......	920	920	......

NOTE.—Stage-discharge relation affected by ice, Nov. 14 to Apr. 17; by logs May 5-25 and June 28.

Monthly discharge of Flambeau River near Ladysmith, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 1,940 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	2,390	1,230	1,750	0.902	1.04
November	2,640	1,670	2,050	1.06	1.18
December	1,910	925	1,330	.686	.79
January	880	660	753	.388	.45
February	660	620	626	.323	.34
March	1,230	605	716	.369	.43
April	6,000	1,340	3,190	1.64	1.83
May	4,480	1,450	2,690	1.39	1.60
June	7,880	1,790	3,340	1.72	1.92
July	3,970	920	1,960	1.01	1.16
August	1,200	740	929	.479	.55
September	1,160	685	884	.456	.51
The year	7,880	605	1,690	.871	11.80

JUMP RIVER AT SHELDON, WIS.

LOCATION.—In sec. 26, T. 33, N., R. 5 W., at highway bridge in Sheldon, Rusk County, 11 miles above confluence of Jump and Chippewa rivers.

DRAINAGE AREA.—510 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—July 22, 1915, to September 30, 1917.

GAGE.—Chain gage bolted to downstream handrail of bridge.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Heavy gravel, clean, and free from vegetation. Right bank high and not subject to overflow; left bank may be overflowed occasionally.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.89 feet at 8 a. m. April 22 (discharge, 4,020 second-feet); minimum discharge estimated 20 second-feet, January and February.

1915–1917: Maximum discharge 8,600 second-feet April 22, 1916; minimum discharge about 18 second-feet January 20, 1916.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 45 and 5,930 second-feet. Gage read to quarter tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for period in which stage-discharge relation was affected by ice, for which it was obtained by applying to rating table mean daily gage height corrected for ice effect by means of discharge measurements, observer's notes, and weather records. Open-water records good; winter records fair.

Discharge measurements of Jump River at Sheldon, Wis., during the year ending Sept. 30, 1917.

[Made by R. B. Kilgore.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1911.	*Feet.*	*Sec.-ft.*	1912.	*Feet.*	*Sec.-ft.*
Jan. 9[a]	3.46	36	Mar. 14[a]	3.65	35
Feb. 9[a]	3.69	24	May 15	3.64	354

[a] Complete ice cover.

Daily discharge, in second-feet, of Jump River at Sheldon, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	195	256	169	35	20	25	840	2,510	330	270	44	45
2	183	310	155	30	20	25	1,020	2,510	355	225	38	44
3	143	285	165	25	20	25	1,200	2,110	330	176	33	39
4	118	251	175	25	25	25	1,510	1,740	330	148	36	39
5	76	238	165	25	25	30	1,620	1,300	380	140	38	55
6	107	207	155	25	25	30	1,860	1,110	840	164	42	88
7	85	195	165	30	25	30	2,370	840	1,300	255	55	148
8	58	246	175	30	25	30	2,370	680	1,510	305	65	148
9	76	680	140	35	25	30	2,650	610	1,510	260	68	112
10	68	930	100	35	25	35	2,510	540	1,110	200	70	65
11	76	930	110	35	25	35	2,950	485	840	176	65	55
12	97	645	120	30	25	35	3,400	458	610	144	60	58
13	91	540	100	30	25	35	3,250	405	485	180	48	77
14	118	540	80	30	25	35	2,650	355	405	176	39	156
15	139	420	75	30	25	35	1,980	330	330	140	33	180
16	132	390	70	25	25	40	1,510	305	280	133	36	164
17	124	360	55	25	20	45	1,200	305	230	136	33	144
18	195	335	40	25	20	60	1,400	275	205	112	36	136
19	179	310	35	25	20	70	1,860	330	185	119	38	112
20	163	260	25	25	20	70	2,510	380	176	122	42	91
21	143	253	35	20	20	85	3,720	430	164	105	42	70
22	143	246	40	20	20	100	3,880	405	160	102	48	68
23	128	204	45	20	20	120	3,250	380	164	88	50	58
24	124	163	50	20	25	135	2,370	330	172	77	48	50
25	132	183	40	20	25	155	1,860	270	280	70	44	50
26	171	203	25	20	25	175	1,510	250	430	65	50	77
27	335	224	25	20	25	215	1,400	220	485	58	48	77
28	285	246	25	20	25	310	1,510	200	430	58	45	148
29	260	214	30	20	......	360	1,860	180	305	50	45	205
30	251	183	40	20	......	480	2,370	185	305	45	48	176
31	260	......	40	20	......	610	......	230	......	44	50	......

NOTE.—Stage-discharge relation affected by ice Nov. 16–20, Dec. 7 to Apr. 4.

Monthly discharge of Jump River at Sheldon, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 510 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	335	58	150	0.294	0.34
November	930	163	348	.682	.76
December	175	25	86.1	.169	.19
January	35	20	25.6	.050	.06
February	25	20	23.2	.046	.05
March	610	25	113	.222	.26
April	3,880	840	2,150	4.22	4.71
May	2,510	180	666	1.31	1.51
June	1,510	160	488	.957	1.07
July	305	44	140	.274	.32
August	70	33	46.4	.091	.10
September	205	39	97.8	.192	.21
The year	3,880	20	359	.704	9.58

EAU CLAIRE RIVER NEAR AUGUSTA, WIS.

LOCATION.—In sec. 12, T. 26 N., R. 6 E., at Trouble Water Bridge, about 7 miles northeast of Augusta, Eau Claire County. South Fork of Eau Claire River enters from left about 4 miles above station.

DRAINAGE AREA.—500 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—July 16, 1914, to September 30, 1917.

GAGE.—Chain gage on downstream side of bridge; read by Albert Wagner.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading at control about 500 feet downstream from bridge.

CHANNEL AND CONTROL.—Bed at bridge and above is sandy and very shifting; a short distance below the gage the channel narrows and a rock outcrop overlain with large boulders forms the control. Banks are high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum open-water stage recorded, during year, 7.08 feet April 3 and 4 (discharge, 3,710 second-feet); a stage of 11.0 feet March 31 was due to backwater from ice; minimum discharge estimated at 25 second-feet January 3–5 and 21–25.

1914–1917: Maximum open-water stage recorded, 10.6 feet at noon April 1, 1916 (discharge, 7,180 second-feet); discharge less at stage of 11.0 feet March 31, 1917, which was due to backwater from ice; minimum discharge January, 1917.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve used October 1 to September 30, well defined from 87 to 5,520 second-feet; poorly defined outside these limits. Gage read to quarter tenths once a day. Daily discharge ascertained by applying daily gage height to rating table, except for period in which stage-discharge relation was affected by ice, for which it was obtained by applying to rating table mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good, except for low stages for which they are fair; winter records fair.

Discharge measurements of Eau Claire River near Augusta, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 2[a]	E. L. Williams	0.93	29	Mar. 22[a]	R. B. Kilgore	2.08	78
Feb. 11[a]	R. B. Kilgore	1.52	47	June 5	....do	2.05	561

[a] Complete ice cover.

Daily discharge, in second-feet, of Eau Claire River near Augusta, Wis., for the year ending Sept. 30, 1917.

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	103	141	235	30	65	40	3,530	1,570	369	129	62	43
2	97	141	179	30	65	40	3,620	1,400	308	129	118	40
3	87	141	249	25	65	40	3,710	1,030	293	107	73	43
4	83	141	221	25	65	40	3,710	833	283	97	62	40
5	73	201	193	25	70	40	3,710	761	369	97	69	40
6	69	179	190	30	70	40	3,530	533	585	107	141	43
7	69	158	155	30	65	40	2,840	449	1,130	118	134	40
8	73	263	130	30	60	40	2,240	385	2,450	125	134	47
9	69	797	85	35	50	45	1,630	353	1,890	107	141	40
10	69	1,400	70	40	45	50	1,290	323	1,030	87	129	40
11	78	833	70	40	45	45	1,130	293	690	107	78	40
12	62	482	60	40	40	50	1,030	283	449	118	73	43
13	78	385	55	50	40	45	869	193	401	107	83	62
14	83	263	45	50	40	45	761	193	278	118	87	66
15	87	250	40	45	40	40	620	166	249	97	69	69
16	83	250	40	40	45	40	550	153	235	91	78	54
17	87	290	35	40	45	40	482	153	179	91	69	57
18	78	323	35	35	45	60	482	141	166	91	69	47
19	78	369	35	30	50	70	550	193	153	83	69	78
20	87	482	30	30	55	75	761	221	107	87	69	62
21	87	308	30	25	45	80	1,130	221	107	83	62	69
22	83	293	30	25	35	80	1,290	249	107	83	62	54
23	78	263	30	25	35	80	905	249	125	91	62	54
24	83	207	30	25	40	85	690	249	129	179	69	78
25	97	220	30	25	40	106	761	235	129	153	54	54
26	153	235	30	30	40	415	833	221	174	118	62	78
27	158	250	30	30	40	835	945	193	166	91	54	179
28	141	263	30	45	40	1,400	761	179	129	78	51	166
29	141	263	30	60	....	2,100	985	153	118	69	47	78
30	141	249	30	60	....	3,170	1,510	166	129	78	43	97
31	141	....	30	65	....	3,440	....	221	....	40	40	....

NOTE.—Stage-discharge relation affected by ice, Nov. 15-17, 25-27, and Dec. 6 to Apr. 2. Discharge Sept. 14 interpolated.

Monthly discharge of Eau Claire River near Augusta, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 500 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	158	62	93.4	0.187	0.22
November	1,400	141	334	.668	.75
December	249	30	79.7	.159	.18
January	65	25	36.0	.072	.08
February	70	35	49.3	.095	.10
March	3,440	40	410	.820	.95
April	3,710	482	1,560	3.12	3.48
May	1,570	141	385	.770	.89
June	2,450	107	431	.862	.96
July	179	40	102	.204	.24
August	141	40	77.8	.156	.18
September	179	40	63.5	.127	.14
The year	3,710	25	301	.602	8.17

RED CEDAR RIVER NEAR COLFAX, WIS.

LOCATION.—In sec. 27, T. 30 N., R. 11 W., at highway bridge about 4½ miles north of Colfax, Dunn County. Hay River enters from right about 11 miles below, and Trout Creek, also from right, 3½ miles above station.

DRAINAGE AREA.—1,100 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—March 10, 1914, to September 30, 1917.

GAGE.—Chain gage attached to downstream side of bridge; read by Andrew Lundeguam.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge to which gage is attached.

CHANNEL AND CONTROL.—Bed composed of rock and gravel; small amount of grass growth during summer months; left bank high and not subject to overflow; right bank medium high and may be overflowed during extremely high water; control not well defined.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.94 feet at 10 a. m. April 3 (discharge 4,380 second-feet); minimum discharge recorded, 435 second-feet March 12.

1914–1917: Maximum stage recorded, 6.8 feet at 1 p. m., March 31, 1916 (discharge 6,990 second-feet); minimum stage recorded 0.80 foot November 19, 1914 (discharge about 385 second-feet), apparently caused by temporary holding back of the water by ice.

REGULATION.[1]—The following dams and reservoirs are used to regulate the flow in the Red Cedar River. Owing to operation of these reservoirs the flow at the station is not natural.

Reservoirs used to regulate flow of Red Cedar River.

Dam.	Location.	Approximate capacity (millions of cubic feet).
Long Lake	Sec. 24, T. 37 N., R. 11 W	1,000
Cedar Lake	Sec. 21, T. 36 N., R. 10 W	965
Birch Lake	Sec. 25, T. 37 N., R. 10 W	1,174
Bear Lake	Sec. 7, T. 36 N., R. 11 W	280
Chetek Lake	Sec. 20, T. 33 N., R. 10 W	998
		4,417

ACCURACY.—Stage-discharge relation nearly permanent, except as affected by ice and possibly by grass from June to September. One curve, well defined between 653 and 4,450 second-feet, was used during the year; curve extended and roughly approximate outside these limits. Gage read to quarter tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for period in which stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes and weather records. Open-water records good; winter records fair.

Discharge measurements of Red Cedar River near Colfax, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 23	R. B. Kilgore	2.01	1,000	Mar. 20[a]	R. B. Kilgore	3.04	618
Jan. 11[a]	Williams and Kilgore	3.03	808	May 18	.....do	1.70	808
Feb. 19[a]	R. B. Kilgore	2.48	478	Aug. 11	.....do	1.31	575

[1] From data on file in Engineering Dept. of Railroad Commission of Wisconsin.
[a] Ice at control.

Daily discharge, in second-feet, of Red Cedar River near Colfax, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	820	720	785	585	610	460	3,000	1,120	1,040	610	585	560
2	925	690	890	610	605	445	3,640	1,210	820	585	560	535
3	960	720	750	635	600	445	4,310	960	750	535	585	512
4	960	690	635	635	600	445	4,030	820	1,210	585	585	535
5	1,000	635	690	660	620	450	3,380	785	1,040	560	535	560
6	960	635	690	690	645	460	2,880	690	820	662	512	560
7	1,040	635	690	690	630	470	2,640	635	1,120	662	635	560
8	925	890	690	720	610	475	2,640	720	960	662	690	560
9	960	890	635	750	580	510	2,530	690	750	635	635	560
10	750	820	470	820	555	540	2,200	690	925	635	585	490
11	662	720	470	810	565	490	2,090	635	785	690	560	535
12	635	690	470	795	575	435	2,090	690	1,000	785	535	585
13	662	690	450	780	510	470	1,980	662	960	610	535	635
14	635	662	450	715	440	510	1,580	690	855	585	535	585
15	635	635	450	650	460	520	1,390	820	785	585	535	560
16	585	690	450	650	475	530	1,210	785	690	610	512	535
17	690	690	450	645	505	555	1,210	750	690	535	535	512
18	690	635	450	660	535	580	1,210	785	585	585	535	535
19	690	785	450	670	520	600	1,210	690	662	535	512	512
20	662	662	450	650	510	620	1,880	750	690	635	512	512
21	690	690	470	635	505	665	1,680	690	690	635	535	490
22	750	690	470	630	500	750	1,120	690	662	610	535	490
23	785	750	470	630	505	820	1,120	662	635	585	535	490
24	785	662	470	685	510	890	1,040	635	635	585	585	470
25	750	560	490	740	480	925	960	635	690	585	560	535
26	855	635	490	710	450	855	890	535	635	585	535	490
27	820	635	510	675	465	960	820	535	610	585	490	490
28	720	750	535	620	480	1,040	820	535	635	560	560	490
29	635	820	535	565	....	1,210	890	535	635	512	535	470
30	610	785	560	590	....	1,480	1,040	662	690	512	512	470
31	720	....	585	610	....	1,980	....	1,000	....	535	535	....

NOTE.—Stage-discharge relation affected by ice Dec. 11 to Apr. 2.

Monthly discharge of Red Cedar River near Colfax, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 1,100 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,040	585	773	0.703	0.81
November	890	560	705	.641	.72
December	890	450	550	.500	.58
January	820	565	675	.614	.71
February	645	440	537	.488	.51
March	1,980	435	696	.633	.73
April	4,310	820	1,920	1.75	1.95
May	1,210	535	732	.665	.77
June	1,210	585	788	.716	.80
July	785	512	599	.545	.63
August	690	490	551	.501	.58
September	635	470	527	.479	.53
The year	4,310	435	753	.685	9.32

RED CEDAR RIVER AT CEDAR FALLS, WIS.

Location.—In sec. 6, T. 28 N., R. 12 W., at highway bridge near Cedar Falls, Dunn County, 4½ miles above crossing of Chicago, St. Paul, Minneapolis & Omaha Railway.

Drainage area.—Not measured.

Records available.—April 1, 1909, to September 30, 1917.

Gage.—Staff fastened to bridge pier; read by John G. Wood.

Discharge measurements.—No discharge measurements made at this station, which is maintained to determine fluctuation in stage.

Channel and control.—Channel rough and rocky, straight, and free from vegetation; banks high and not subject to overflow.

Extremes of stage.—Maximum stage recorded during year, 5.9 feet April 3 and 4; minimum stage, 0.0 foot, 5 p. m. March 11.

1909–1917: Maximum stage recorded, 6.1 feet April 1–3, 1916; minimum stage recorded 0.0 foot at 5 p. m. March 11, 1917. Minimum stages are caused by closing gates and wheels in dam above station.

Regulation.—The operation of storage reservoirs in the headwaters of the river (see "Regulation" in station description for Red Cedar River at Colfax, Wis.), together with storage at the power plant above the gaging station, modify the flow.

Accuracy.—Gage read twice daily to half-tenths. No measurements have been made, but stage-discharge relation believed permanent. Considerable diurnal fluctuation is observed, so that mean daily gage height does not represent the average stage.

Cooperation.—Gage-height record furnished by Wisconsin & Minnesota Light & Power Co.

Daily gage height, in feet, of Red Cedar River at Cedar Falls, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.9	2.75	3.0	2.42	2.5	2.5	5.05	3.3	3.1	2.4	2.25	2.45
2	3.0	2.58	2.72	3.0	2.5	2.5	5.65	3.25	3.72	2.5	2.3	2.1
3	3.0	2.58	1.6	3.0	2.5	2.4	5.85	3.15	3.92	2.38	2.2	1.55
4	3.0	2.58	3.08	2.9	1.45	1.4	5.9	2.85	3.32	2.3	2.3	2.6
5	2.75	1.72	3.0	2.75	2.55	2.5	5.6	2.7	3.3	2.45	2.0	2.5
6	2.75	2.62	3.0	2.68	2.55	2.5	5.05	2.5	3.4	2.42	2.3	2.55
7	2.7	2.62	3.0	1.5	3.0	2.45	4.65	2.95	3.32	2.4	2.35	2.68
8	1.9	2.98	2.72	2.95	2.8	2.3	4.55	2.75	3.28	2.6	2.4	2.5
9	2.72	3.02	2.72	3.0	2.8	1.85	4.65	2.4	3.55	2.7	2.35	1.6
10	2.72	3.08	1.6	2.9	2.85	2.5	4.35	2.25	3.15	2.55	2.3	2.45
11	2.75	3.02	2.72	3.0	1.5	1.2	4.15	2.4	3.42	2.6	2.25	2.5
12	2.75	2.38	2.72	3.0	2.5	2.5	4.15	2.3	3.3	2.45	1.9	2.5
13	2.75	2.98	2.72	2.75	2.7	2.5	4.1	2.15	3.35	2.4	2.5	2.55
14	2.75	2.58	2.72	1.65	2.5	2.5	3.95	2.4	3.55	2.45	2.55	2.65
15	1.9	2.58	2.68	2.85	2.4	2.3	3.45	2.4	3.4	2.3	2.5	2.6
16	2.75	2.78	2.62	3.1	2.4	2.5	3.55	2.75	3.1	2.65	2.55	2.35
17	2.75	2.72	1.55	3.0	2.1	1.9	3.35	2.68	2.3	2.75	2.5	2.5
18	2.78	2.72	2.62	2.9	1.4	1.4	3.4	2.6	2.25	2.45	2.55	2.55
19	2.8	1.82	2.68	2.8	2.7	1.45	3.48	2.5	2.35	2.35	2.0	2.45
20	2.75	2.78	2.68	2.85	3.0	2.7	3.55	2.3	2.3	2.4	2.45	2.45
21	2.52	2.78	2.62	1.55	2.45	2.8	3.45	2.4	2.45	2.4	2.3	2.6
22	1.8	2.72	2.62	3.0	2.5	2.4	3.15	2.6	2.4	2.0	2.3	2.55
23	2.75	2.72	2.68	3.0	2.5	2.5	3.55	2.52	2.2	2.2	2.35	2.0
24	2.75	2.72	1.52	2.5	2.5	2.6	3.25	2.52	1.9	2.4	2.3	2.55
25	2.58	2.72	1.52	2.8	1.4	1.4	3.3	2.25	1.85	2.55	2.35	2.5
26	2.58	1.6	3.0	2.9	2.5	3.05	3.18	1.98	2.38	2.4	2.0	2.55
27	3.0	2.8	2.9	2.8	2.6	3.35	3.15	1.85	2.65	2.2	2.35	2.5
28	2.68	2.72	2.95	1.4	2.4	3.6	2.75	2.68	2.6	2.3	2.45	2.45
29	1.9	2.8	2.88	2.75	....	3.85	2.68	2.3	2.4	2.0	2.5	2.4
30	2.75	1.6	2.95	2.8	....	3.95	3.25	2.3	2.45	2.25	2.4	2.0
31	3.0	....	2.05	2.6	....	5.25	....	2.68	....	2.45	2.6	....

RED CEDAR RIVER AT MENOMONIE, WIS.

LOCATION.—In sec. 21, T. 28 N., R. 13 W., about 900 feet below power house of Wisconsin & Minnesota Light & Power Co., Menominie, Dunn County, 13 miles above the confluence of Red Cedar and Chippewa rivers. Wilson Creek discharges from right into service reservoir just above station.

DRAINAGE AREA.—1,810 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—June 16, 1907, to September 5, 1908; May 9, 1913, to September 30, 1917.

GAGE.—Barrett & Lawrence water-stage recorder installed May 9, 1913, over a wooden well on right bank of river about 1 mile above the site of old gage attached to a highway bridge about 200 rods west of the Chicago & North Western Railway station west of Menomonie, which was read from June 16, 1907, to September 5, 1908. No relation between datums of the two gages. Gage inspected by E. Kasrud.

DISCHARGE MEASUREMENTS.—Made from highway bridge about 1 mile below the gage.

CHANNEL AND CONTROL.—Bed at gage composed of heavy gravel; left bank high and not subject to overflow; right bank of medium height will be overflowed at flood stages; bed at measuring section sandy and liable to shift; both banks high at measuring section and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year about 6.3 feet April 3 (discharge, 8,300 second-feet); minimum stage recorded 1.92 feet at 1 p. m. November 20 (discharge, 394 second-feet).

1907–8 and 1913–1917: Maximum discharge, 12,700 second-feet March 31 and April 1, 1916; minimum discharge, 100 second-feet November 9, 1907.

REGULATION.—Considerable diurnal fluctuation in stage at the gage section is caused by the operation of the power plants of the Wisconsin & Minnesota Light & Power Co. at Menomonie and Cedar Falls. (See "Regulation" in station description for Red Cedar River at Colfax, Wis.)

ICE.—Stage-discharge relation not affected by ice.

ACCURACY.—Stage-discharge relation changed during high water of April 1916, but has been fairly permanent since. Ice does not affect the stage-discharge relation at this station owing to relatively warm water coming from service reservoir. Rating curve well defined between 610 and 1,910 second-feet, and between 3,910 and 9,220 second-feet. Curve extended outside these limits and roughly approximate only. Operation of water-stage recorder satisfactory except for brief periods. Daily-discharge record October 1 to September 30 except for brief periods obtained with discharge integrator. Records good except for periods when gage was not in operation, for which they are only roughly approximate.

Discharge measurements of Red Cedar River at Menomonie, Wis., during the year ending Sept. 30, 1917.

[Made by R. B. Kilgore.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Feb. 21	2.52	864	Apr. 2	6.06	7,550
Apr. 2	5.78	6,840	Aug. 8	2.70	1,000

Daily discharge, in second-feet, of Red Cedar River at Menomonie, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	745	1,130	1,050	1,000	940	850	5,240	1,580	1,450	870	910	1,210
2	920	950	1,310	1,280	960	890	6,900	1,900	1,630	970	730	870
3	1,300	1,010	810	1,430	920	810	7,340	1,570	1,150	1,080	760	650
4	1,350	1,060	1,060	1,400	750	650	7,640	1,600	1,870	880	810	780
5	1,280	700	1,280	1,050	890	680	6,880	1,260	1,670	930	710	1,040
6	1,110	840	1,230	880	980	780	5,690	1,010	1,600	1,260	600	1,140
7	1,200	1,030	1,390	660	1,180	910	4,500	1,580	1,810	1,080	880	1,090
8	660	1,270	1,040	1,060	1,370	880	4,160	1,420	1,480	940	1,070	1,060
9	760	1,370	1,090	1,240	1,170	760	4,560	1,120	1,370	1,450	1,140	530
10	900	1,380	770	1,290	970	800	3,860	1,000	1,360	1,310	1,190	840
11	1,130	1,340	910	1,240	800	610	3,200	1,120	1,550	1,330	1,220	930
12	1,250	900	1,160	1,300	830	770	3,080	1,100	1,510	950	780	1,060
13	1,120	1,190	1,160	1,210	1,030	920	2,810	680	1,330	1,190	900	1,020
14	1,100	1,140	1,230	800	910	800	2,880	1,070	1,330	960	950	960
15	600	1,090	1,120	880	930	800	2,110	1,240	1,220	890	950	890
16	880	1,180	940	1,320	780	710	2,180	1,160	1,080	1,000	940	800
17	1,020	1,110	680	1,460	750	660	1,840	1,280	1,820	1,140	990	830
18	1,180	1,020	750	1,450	680	480	1,890	1,200	1,430	1,020	920	1,110
19	1,080	840	970	1,330	860	680	1,710	1,100	1,150	990	730	1,120
20	1,130	800	1,040	1,430	980	700	2,160	760	1,210	1,020	940	900
21	870	1,040	900	1,010	1,000	890	2,240	1,140	1,140	950	880	870
22	650	1,190	860	920	940	930	1,480	1,230	1,040	880	980	890
23	740	1,160	830	1,190	940	1,290	1,920	1,200	1,200	850	940	630
24	970	1,170	610	1,280	1,000	1,250	1,600	1,080	770	1,020	1,120	740
25	1,050	1,010	640	1,290	840	1,070	2,140	1,020	740	1,300	840	970
26	930	720	910	1,260	870	1,680	1,420	1,000	780	1,110	760	1,010
27	1,010	930	1,210	1,300	940	1,950	1,590	640	780	1,080	800	990
28	1,230	1,150	1,380	900	940	2,760	1,520	940	910	940	890	920
29	710	1,000	1,340	910	....	3,000	1,010	1,130	920	830	900	890
30	1,010	780	1,180	1,240	....	3,130	1,810	740	950	810	1,030	660
31	1,130	....	1,190	1,380	....	4,830	....	1,250	....	780	1,000	....

NOTE.—Recording gage not in operation Oct. 1–3; determinations of discharge based on one gage reading a day, records of Red Cedar River at Cedar Falls, and interpolation. Discharge Nov. 29, 30, and Jan. 7 based on average gage height for less than 24 hours.

Monthly discharge of Red Cedar River at Menomonie, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 1,810 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,350	600	999	0.552	0.64
November	1,380	700	1,050	.580	.65
December	1,390	610	1,030	.569	.66
January	1,460	660	1,170	.646	.74
February	1,370	680	934	.516	.54
March	4,830	480	1,220	.674	.78
April	7,640	1,010	3,250	1.80	2.01
May	1,900	640	1,170	.646	.74
June	1,870	740	1,280	.707	.79
July	1,450	780	1,030	.569	.66
August	1,220	600	912	.504	.58
September	1,210	530	913	.504	.56
The year	7,640	480	1,240	.685	9.35

ZUMBRO RIVER AT ZUMBRO FALLS, MINN.

LOCATION.—Near east border of sec. 31, T. 110 N., R. 14 W., at highway bridge at Zumbro Falls, about 1,500 feet below mouth of Spring Creek, 6½ miles below mouth of South Branch.

DRAINAGE AREA.—1,120 square miles.

RECORDS AVAILABLE.—June 8, 1909, to September 30, 1917, when station was discontinued.

GAGE.—Chain attached to the upstream handrail of bridge near left end; read by A. H. Sugg.

DISCHARGE MEASUREMENTS.—Made from the bridge or by wading.

CHANNEL AND CONTROL.—Bed of stream is fine sand; shifts considerably; a slight riffle a few hundred feet below gage acts as a partial control during low stages; right bank is fairly low and is overflowed during high flood stages; left bank not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 19.04 feet at 4.50 p. m. March 25 (discharge, about 14,800 second-feet); flood peak was increased somewhat by going out of dam at Mazeppa, about 6 miles upstream, during the afternoon of March 25. Dam created a head of 22 feet and had a pond area of about 150 acres. Minimum discharge estimated 150 second-feet January 13 to February 15.

1907–1917: Maximum stage recorded March 25, 1917; minimum open-water stage recorded, 4.50 feet at 8 a. m. January 10 and 21, 1914 (discharge, about 128 second-feet); 106 second-feet was measured by current meter January 27, 1915.

High-water of June, 1908, which reached a stage of 26.7 feet above datum of present gage, is marked by a spike in a telephone post near the railroad station at Zumbro Falls; high water of April, 1888, reached a stage of approximately 29.7 feet, as shown by a mark not so well defined as that of the flood of 1908.

ICE.—Stage-discharge relation not seriously affected by ice except during and after extremely cold weather, when ice forms below the gage and causes backwater for short periods. A short distance above the gage the river receives about 8 second feet of spring water from Spring Creek, which is warm enough to keep it free from ice for a considerable distance during most winter weather.

REGULATION.—The slight artificial regulation at the power plants above Zumbro Falls is not observable at the gage.

ACCURACY.—Stage-discharge relation not permanent; change occurred during high-water of March. Rating curve used October 1 to March 22 and May 29 to September 30, poorly defined; curve used March 23 to May 28 poorly defined throughout. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except during period when stage-discharge relation was affected by ice, for which it was obtained by applying to rating table mean daily gage height corrected for effect of ice by means of discharge measurement, observer's notes, and weather records. Open-water records good except those for flood stages, which are subject to error; winter records fair.

Discharge measurements of Zumbro River at Zumbro Falls, Minn., during the period Oct. 1, 1916, to Oct. 6, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1917.		*Feet.*	*Sec.-ft.*	1917.		*Feet.*	*Sec.-ft.*
Jan. 11[a]	S. B. Soulé	4.92	160	June 8	S. B. Soulé	9.05	2,080
Feb. 20[a]	....do	4.86	167	Oct. 6	R. B. Kilgore	5.24	236
Mar. 28	R. B. Kilgore	10.46	3,580				

[a] Ice at control section.

Daily discharge, in second-feet, of Zumbro River near Zumbro Falls, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	210	233	220	170	150	180	1,850	1,030	2,160	680	318	224
2	206	233	220	170	150	180	1,470	1,030	1,550	740	318	210
3	210	233	210	170	150	180	1,240	880	1,020	580	302	224
4	206	222	210	170	150	180	1,240	758	870	520	302	224
5	208	222	210	170	150	180	1,410	690	820	500	302	210
6	200	233	210	170	150	180	1,410	622	1,020	520	335	210
7	202	245	210	160	150	191	1,240	555	1,370	600	406	210
8	202	282	210	160	150	195	1,030	510	2,220	680	820	210
9	202	308	210	160	150	197	880	490	1,550	600	700	224
10	204	366	210	160	150	200	805	450	1,120	500	520	210
11	210	322	210	160	150	210	735	430	870	740	388	224
12	222	308	200	160	150	202	690	410	560	920	352	224
13	233	257	200	150	150	189	622	370	640	820	335	224
14	233	245	200	150	150	169	600	390	560	680	318	210
15	510	235	200	150	150	210	532	370	500	580	302	210
16	510	235	190	150	160	222	555	350	443	540	318	210
17	206	235	190	150	160	179	510	330	443	500	286	196
18	206	235	190	150	160	189	555	350	406	462	286	210
19	222	220	190	150	160	210	578	430	388	424	270	224
20	233	220	190	150	170	222	735	490	370	424	270	270
21	222	220	190	150	170	257	1,030	510	388	406	318	462
22	222	220	190	150	170	1,270	1,240	600	370	406	302	443
23	222	220	190	150	170	9,670	880	758	424	388	286	352
24	233	220	180	150	170	8,970	805	735	540	481	270	302
25	257	220	180	150	170	14,000	780	555	1,490	443	254	270
26	257	220	180	150	170	8,690	805	510	1,270	388	224	254
27	257	220	180	150	170	5,050	880	578	1,020	352	224	352
28	257	220	180	150	170	3,550	780	622	820	352	224	318
29	257	220	180	150	....	1,920	735	580	820	318	224	286
30	245	220	170	150	....	2,340	780	620	820	302	210	270
31	245	....	170	150	....	2,060	....	2,360	....	318	224	....

NOTE.—Stage-discharge relation affected by ice Nov. 14 to Mar. 6.

Monthly discharge of Zumbro River near Zumbro Falls, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 1,120 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	510	200	242	0.216	0.25
November	366	220	243	.217	.24
December	220	170	196	.175	.20
January	170	150	156	.139	.16
February	170	150	158	.141	.15
March	14,000	169	1,990	1.78	2.05
April	1,850	510	913	.815	.91
May	2,360	330	625	.558	.64
June	2,220	370	895	.799	.89
July	920	302	521	.465	.54
August	820	210	329	.294	.34
September	462	196	256	.229	.26
The year	14,000	150	546	.488	6.63

SOUTH BRANCH OF ZUMBRO RIVER NEAR ZUMBRO FALLS, MINN.

LOCATION.—In sec. 22, T. 109 N., R. 14 W., at Woodville Bridge, 1¼ miles above mouth of river, 6 miles below mouth of Middle Branch, and 6 miles southwest of Zumbro Falls, Wabasha County.

DRAINAGE AREA.—821 square miles.

RECORDS AVAILABLE.—June 16, 1911, to September 30, 1917, when station was discontinued.

GAGE.—Chain gage attached to the downstream handrail of bridge near center of river; read by W. M. Whipple.

DISCHARGE MEASUREMENTS.—At high and medium stages made from downstream side of the bridge; at low stages made by wading.

CHANNEL AND CONTROL.—Bed of stream consists chiefly of sand and gravel. Control consists of cobble stones and rock at a well-defined riffle a short distance below the gage; fairly permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 14.1 feet at 6 p. m. March 23 (discharge, about 12,100 second-feet); minimum discharge estimated, 100 second-feet February 11–24.

1911–1917: Maximum stage recorded March 23, 1917; minimum stage recorded, 1.80 feet December 26, 1914 (discharge, 62 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; flow estimated from discharge measurements, observer's notes, and weather records.

REGULATION.—Effects of operation of small power plants above the station not noticeable at gage.

ACCURACY.—Stage-discharge relation fairly permanent except as affected by ice. Rating curve fairly well defined. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except during period when stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table mean daily gage height corrected for effect of ice, by means of discharge measurements, observer's notes, and weather records. Open-water records good except those for extreme flood stages, which are subject to error; winter records fair.

Discharge measurements of South Branch of Zumbro River near Zumbro Falls, Minn., during the period Oct. 1, 1916, to Oct. 6, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1917		*Feet.*	*Sec.-ft.*	1917		*Feet.*	*Sec.-ft.*
Jan. 10[a]	S. B. Soulé	2.28	119	June 9	S. B. Soulé	4.46	1,510
Feb. 20[a]	.....do	2.22	102	Oct. 6	R. B. Kilgore	2.06	163
Mar. 27	R. B. Kilgore	6.79	3,210				

[a] Made through complete ice cover.

Daily discharge, in second-feet, of South Branch of Zumbro River near Zumbro Falls, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	150	145	150	125	110	110	1,480	678	2,530	594	269	177
2	154	140	145	125	110	110	973	678	1,480	594	256	170
3	148	150	142	125	110	110	882	650	412	488	247	166
4	158	150	142	125	110	110	852	540	735	358	230	170
5	154	150	145	125	110	110	1,097	514	678	364	243	170
6	145	148	140	125	110	140	973	488	912	437	273	166
7	140	154	142	125	110	273	793	462	2,130	462	341	173
8	150	150	142	125	110	262	735	437	1,480	437	852	173
9	142	300	132	120	110	256	622	388	1,360	462	622	170
10	142	282	125	120	110	230	488	341	973	358	388	166
11	135	222	125	120	100	189	462	314	706	622	314	162
12	142	210	125	115	100	189	488	296	650	973	314	162
13	145	177	125	110	100	145	462	269	488	706	278	162
14	150	158	125	110	100	120	412	264	412	540	252	162
15	148	150	125	110	100	201	388	269	412	462	234	170
16	145	154	125	110	100	140	359	278	388	388	230	170
17	148	170	125	110	100	140	346	264	412	327	226	173
18	142	150	125	110	100	150	364	269	359	355	234	170
19	142	150	125	110	100	170	388	309	336	336	222	243
20	142	162	125	110	100	145	462	388	327	323	230	650
21	148	158	125	110	100	218	594	462	314	309	278	514
22	148	158	125	110	100	1,960	1,040	567	309	304	234	359
23	142	150	125	110	100	4,520	764	622	388	296	218	300
24	150	150	125	110	100	7,060	594	514	488	341	201	264
25	181	154	125	110	110	7,720	540	437	678	323	189	226
26	177	166	125	110	110	5,320	622	412	1,480	300	185	269
27	181	154	125	110	110	3,720	594	488	1,220	278	189	412
28	177	145	125	110	110	2,710	540	540	706	264	193	252
29	166	145	125	110	....	2,060	488	488	882	243	181	226
30	154	142	125	110	....	1,620	622	622	706	239	177	210
31	162	....	125	110	....	1,620	....	1,760	....	247	173	....

NOTE.—Stage-discharge relation affected by ice Dec. 10 to Mar. 6.

Monthly discharge of South Branch of Zumbro River near Zumbro Falls, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 821 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	181	135	152	0.185	0.21
November	300	140	166	.202	.23
December	150	125	130	.158	.18
January	125	110	115	.140	.16
February	110	100	105	.128	.13
March	7,720	110	1,350	1.64	1.89
April	1,480	346	647	.788	.88
May	1,760	264	484	.590	.68
June	2,530	309	812	.989	1.10
July	973	239	413	.503	.58
August	852	173	273	.333	.38
September	650	162	232	.283	.32
The year	7,720	100	408	.497	6.74

TREMPEALEAU RIVER AT DODGE, WIS.

LOCATION.—In sec. 11, T. 19 N., R. 10 W., at highway bridge in Dodge, Trempealeau County, 9 miles above mouth of river.

DRAINAGE AREA.—633 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—December 13, 1913, to September 30, 1917.

GAGE.—Chain gage attached to downstream side of bridge; read by J. Johnson and F. E. Shappee.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Sand; likely to shift. Banks of medium height and may be overflowed during extreme floods.

EXTREMES OF DISCHARGE.—Maximum discharge 1,640 second-feet, March 30 and 31; minimum discharge about 120 second-feet, January 21–23.

1914–1917: Maximum stage recorded, 8.35 feet, June 9, 1914 (discharge, 3,340 second-feet); minimum discharge, January 21–23, 1917.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—No power plants above station have sufficient capacity to affect the natural flow of the river.

ACCURACY.—Stage-discharge relation not permanent. Two rating curves used as follows: October 1 to March 31, fairly well defined between 196 and 1,800 second-feet; April 1 to September 30, well defined between 191 and 1,800 second-feet, and fairly well defined between 1,800 and 3,080 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except for period when stage-discharge relation was affected by ice, for which it was obtained by applying to rating table mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good, except at extreme flood stages, for which they are fair; winter records fair.

Discharge measurements of Trempealeau River at Dodge, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 3[a]	E. L. Williams	2.59	153	Mar. 23[a]	R. B. Kilgore	5.35	643
Feb. 12[a]	R. B. Kilgore	3.16	210	June 6	.....do	2.37	358

[a] Complete ice cover.

Daily discharge, in second-feet, of Trempealeau River at Dodge, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	296	348	322	145	190	225	1,600	721	383	358	248	181
2	270	296	322	145	210	220	1,600	721	383	358	236	171
3	270	309	322	155	235	220	1,600	642	358	333	236	162
4	270	309	296	165	235	220	1,390	564	358	333	213	202
5	257	296	309	160	235	220	1,090	459	383	383	260	162
6	244	296	322	160	220	230	955	459	408	459	260	153
7	257	309	322	160	205	245	903	433	590	383	284	171
8	244	452	309	165	210	260	799	433	537	358	308	171
9	257	618	270	170	215	270	721	408	511	358	308	181
10	270	590	255	175	215	285	669	383	433	408	260	153
11	270	534	245	170	215	300	669	383	383	485	236	181
12	283	426	230	170	210	310	616	383	358	459	248	171
13	322	374	220	170	210	320	616	358	333	358	260	191
14	296	374	210	165	210	330	564	333	308	333	236	191
15	296	478	195	165	210	335	537	333	308	308	236	181
16	270	478	175	165	215	330	511	308	284	284	224	181
17	270	534	155	160	220	320	511	308	284	260	213	162
18	270	506	145	160	220	335	511	296	260	248	181	171
19	270	478	135	160	220	355	669	408	260	236	181	202
20	309	452	125	155	220	375	825	408	260	236	181	284
21	296	452	120	155	225	400	877	459	260	236	171	236
22	283	452	120	155	230	445	799	590	248	260	191	236
23	270	452	120	155	240	645	695	564	383	296	181	236
24	296	452	125	160	235	850	616	408	564	284	181	191
25	374	452	125	160	230	1,090	616	358	590	284	181	191
26	374	426	125	160	225	1,360	616	358	642	260	181	236
27	400	426	125	180	220	1,470	590	358	485	236	181	284
28	374	452	135	195	220	1,550	537	333	433	213	181	260
29	348	400	135	200	....	1,590	642	358	408	202	181	248
30	322	374	135	210	....	1,640	669	383	358	202	171	213
31	348	....	135	200	....	1,640	....	408	....	181	171	....

NOTE.—Stage-discharge relation affected by ice Dec. 10 to Mar. 31.

Monthly discharge of Trempealeau River at Dodge, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 633 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	400	244	296	0.468	0.54
November	618	296	426	.673	.75
December	322	120	203	.321	.37
January	210	145	167	.264	.30
February	240	190	219	.346	.36
March	1,640	220	592	.935	1.08
April	1,600	511	800	1.26	1.41
May	721	296	430	.679	.78
June	642	248	392	.619	.69
July	485	181	309	.488	.56
August	308	171	219	.346	.40
September	284	153	198	.313	.35
The year	1,640	120	354	.559	7.59

BLACK RIVER AT NEILLSVILLE, WIS.

Location.—In sec. 15, T. 24 N., R. 2 W., at lower highway bridge in Neillsville, Clark County. O'Neil Creek enters from left about a mile above gage and Cunningham Creek, also from left, about 1½ miles below.

Drainage area.—774 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

Records available.—April 7, 1905, to March 31, 1909; December 11, 1913, to September 30, 1917.

Gage.—Chain gage fastened to downstream side of highway bridge; read by A. Bissell.

Discharge measurements.—Made from downstream side of bridge or by wading in vicinity of bridge.

Channel and control.—Bed composed of heavy gravel and rock; control at head of rapids, a few hundred feet below gage; banks high and rocky; water will not overflow the banks at the gage section.

Extremes of discharge.—Maximum stage recorded during year, 10.35 feet at 8 a. m. April 4 (discharge, 7,200 second-feet); minimum discharge estimated, 25 second-feet December 25–31. Owing to diurnal fluctuations at such low stages it is likely that the absolute minimum was somewhat less.

1905–1909 and 1913–1917: Maximum stage recorded, 19.8 feet June 6, 1905 (discharge, about 29,400 second-feet). It is probable that the maximum discharge which occurred October 6, 1911, exceeded 29,000 second-feet, although data are not available regarding the stage at the gage section during this flood. Minimum stage recorded during open-water periods, 2.4 feet October 9, 1905 (discharge, about 20 second-feet).

Regulation.—Several dams on Black River and tributaries upstream from Neillsville are used to create a head for developing power. The operation of these plants causes a diurnal fluctuation at the gage, especially during the winter, when the flow is at a minimum.

Accuracy.—Stage-discharge relation practically permanent except as affected by ice. Rating curve well defined from 48 to 14,300 second-feet; fairly well defined below 48 second-feet and extended above 14,300 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for periods in which stage-discharge relation was affected by ice, for which it was obtained by applying to rating table gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good, except for extremely low stages, for which they are fair; winter records poor.

Discharge measurements of Black River at Neillsville, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 2[a]	E. L. Williams	2.70	27	Mar. 15[a]	R. B. Kilgore	3.70	51
Feb. 10[a]	R. B. Kilgore	3.30	34	June 8	....do	7.60	3,190

[a] Complete ice cover.

Daily discharge, in second-feet, of Black River at Neillsville, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	315	374	181			40	4,850	3,360	260	165	54	42
2	260	438	187			40	5,160	2,900	334	104	59	41
3	192	416	173			40	5,800	2,260	354	90	47	42
4	160	416	170			40	6,940	1,640	315	84	43	40
5	122	585	157			40	5,800	1,230	610	86	40	42
6	108	510	145			40	5,640	950	1,080	102	45	43
7	102	416	130			50	5,160	770	2,960	84	63	43
8	97	890	120		35	50	4,290	660	3,260	63	94	43
9	97	2,860	100			50	3,680	585	2,460	47	108	43
10	86	2,660	90			50	3,060	460	1,640	49	112	54
11	84	1,800	85			50	2,860	416	1,150	68	110	47
12	87	1,290	70			50	2,960	334	770	86	92	46
13	108	890	65			50	2,760	296	585	87	416	47
14	104	485	60			50	2,260	260	395	104	170	59
15	116	395	50			50	1,720	241	278	69	97	53
16	122	438	40	30		50	1,290	184	225	58	70	59
17	112	438	40			60	1,080	198	181	56	64	47
18	110	296	35			60	1,010	184	157	60	47	63
19	104	296	35			70	1,800	204	125	57	47	64
20	118	260	30			70	2,460	210	120	56	44	71
21	134	228	30			85	4,290	260	110	48	43	64
22	104	198	30		40	100	4,030	374	97	81	46	57
23	100	185	30			145	2,860	395	104	187	52	47
24	98	185	30			230	2,160	354	120	173	50	43
25	142	170	25			415	1,640	260	134	142	50	46
26	122	170	25			660	1,500	231	122	102	58	50
27	296	170	25			2,070	2,070	198	83	78	43	47
28	334	170	25			3,060	2,070	173	120	58	42	50
29	315	176	25		....	3,680	2,560	154	120	53	40	106
30	315	192	25		....	4,290	3,160	154	134	52	39	97
31	355	....	25		....	4,560	....	204	....	48	41	....

NOTE.—Stage discharge relation affected by ice Nov. 23–28, and Dec. 6 to Apr. 1. Braced figures show mean discharge for period included.

Monthly discharge of Black River at Neillsville, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 774 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	355	84	159	0.206	0.24
November	2,860	170	600	.775	.86
December	187	25	72.8	.094	.11
January	30	30	30.0	.039	.04
February	40	35	37.3	.048	.05
March	4,560	40	655	.846	.98
April	6,940	1,010	3,230	4.17	4.65
May	3,360	154	648	.837	.96
June	3,260	83	613	.792	.88
July	187	47	83.8	.108	.12
August	416	39	75.0	.097	.11
September	106	40	53.3	.069	.08
The year	6,940	25	519	.671	9.08

LA CROSSE RIVER NEAR WEST SALEM, WIS.

LOCATION.—In sec. 32, T. 17 N., R. 6 W., La Crosse County, at Highway bridge 2 miles west of West Salem and 10 miles above mouth of river. Dutch Creek enters from right 6 miles above station.

DRAINAGE AREA.—412 square miles (measured on map issued by Wisconsin Geological & Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—December 22, 1913, to September 30, 1917.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge at medium and high stages; at low stages made by wading.

CHANNEL AND CONTROL.—Bed heavy gravel and rock. Right bank high and not subject to overflow; left bank above the gage low, and subject to overflow at flood stages. Channel free from vegetation; control for low stages a rocky riffle with a fall of about 6 inches. Control is apparently drowned out at a stage of about 2.2 feet on the gage as shown by a reversal in the rating curve.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.4 feet, at 5 p. m. March 24 (discharge, about 2,850 second-feet); minimum discharge, 130 second-feet, January 14.

1913–1917: Maximum stage recorded March 24, 1917; minimum discharge, 130 second-feet, November 17, 1914, and January 14, 1917.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—Diurnal fluctuation at low stages amounting to 0.10 to 0.40 foot, is caused by the operation of power plants, especially the Neshonock dam a few miles above station.

ACCURACY.—Stage-discharge relation permanent, except as affected by ice. Rating curve well defined between 212 and 2,300 second-feet. Gage read to quarter tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for periods in which stage-discharge relation was affected by ice, for which it was obtained by applying to rating table mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good, except for low stages, for which they are fair; winter records fair.

Discharge measurements of La Crosse River near West Salem, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 4[a]	E. L. Williams	1.90	211	Mar. 24	R. B. Kilgore	5.98	2,000
Feb. 13[a]	F. B. Kilgore	2.47	214	May 17[b]	E. L. Williams	1.56	309

[a] Ice at control. [b] Made from the bridge; very poor measuring section at this stage.

Daily discharge, in second-feet, of La Crosse River near West Salem, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	308	308	288	200	240	175	461	638	328	371	328	244
2	288	288	288	200	220	185	438	658	328	416	573	241
3	288	288	248	195	205	185	416	638	350	416	862	241
4	288	288	288	210	145	165	394	484	416	328	461	234
5	244	248	268	195	205	205	394	416	394	288	371	248
6	248	288	268	205	185	210	371	350	438	328	350	268
7	234	268	268	160	165	185	288	371	616	328	328	268
8	212	328	268	195	200	225	268	328	749	308	350	288
9	248	328	268	190	200	250	308	328	749	328	371	288
10	241	350	255	185	185	250	328	328	654	288	328	288
11	248	328	248	180	170	250	308	308	560	308	308	268
12	248	308	248	180	200	330	288	308	466	328	328	248
13	248	328	240	170	190	340	288	288	371	288	416	230
14	288	350	230	130	175	365	288	288	371	288	416	208
15	248	308	210	170	250	355	248	288	328	248	371	288
16	288	308	205	160	235	335	288	288	328	288	328	234
17	248	371	200	175	200	330	268	288	288	268	308	248
18	241	394	195	160	165	280	528	288	308	268	308	248
19	234	328	195	165	225	300	2,060	328	288	248	268	288
20	268	308	185	155	225	270	1,600	350	288	248	288	308
21	288	288	185	145	230	330	1,000	394	288	248	268	328
22	308	288	180	175	205	695	715	438	288	551	268	288
23	328	288	180	160	195	1,910	638	461	371	1,150	248	248
24	308	288	180	175	195	2,480	461	394	416	1,230	268	288
25	328	270	180	175	165	1,510	438	350	461	835	268	248
26	350	248	185	185	220	1,090	461	328	484	506	244	248
27	371	328	185	195	210	916	461	371	438	371	248	268
28	371	288	185	165	200	715	416	416	394	328	244	224
29	328	288	185	220	....	595	438	371	416	308	248	234
30	328	288	195	215	....	506	551	328	438	308	241	219
31	328	....	195	215	....	461	....	328	....	288	244	....

NOTE.—Stage-discharge relation affected by ice Nov. 25, Dec. 10 and Dec. 13 to Mar. 24. Gage not read June 10–12; discharge interpolated.

Monthly discharge of La Crosse River near West Salem, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 412 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	371	212	284	0.689	0.[illegible]
November	394	248	306	.743	.[illegible]
December	288	180	223	.541	.[illegible]
January	220	130	181	.439	.[illegible]
February	250	145	200	.485	.[illegible]
March	2,480	165	529	1.28	1.[illegible]
April	2,060	248	514	1.25	1.[illegible]
May	658	288	379	.920	1.[illegible]
June	749	288	420	1.02	1.[illegible]
July	1,230	248	397	.964	1.[illegible]
August	862	241	337	.818	.[illegible]
September	328	219	261	.633	.[illegible]
The year	2,480	130	336	.816	11.[illegible]

ROOT RIVER NEAR HOUSTON, MINN.

Location.—In sec. 34, T. 104 N., R. 6 W., at highway bridge 1 mile east of Houston, Houston County, 1 mile above mouth of South Root River.

Drainage area.—1,560 square miles.

Records available.—May 28, 1909, to Sept. 30, 1917, when station was discontinued.

Gage.—Vertical staff bolted to the downstream side of the stone abutment, right end of bridge, read by Olaf Larson. Prior to June 28, 1913, gage was attached to piling just above the right abutment. The datum of the present gage was changed slightly on date of installation to allow for slight slope in river between the two points.

Discharge measurements.—Made from the downstream side of bridge.

Channel and control.—No well-defined control. Bed of stream is silt and fine sand that scours during floods and gradually fills in afterwards. Banks subject to overflow at stage of about 8.5 feet, the overflow at the gage attaining at times a width of about 5,000 feet. Floods on the South Root, which enters the main Root about a mile below station, at times produce considerable backwater at the gage.

Extremes of discharge.—Maximum stage recorded during year, about 11.95 feet March 24 (discharge estimated, because of ice, about 17,000 second-feet); minimum discharge estimated during period river was frozen over was 280 second-feet Feb. 12 to 22, 24 and March 4.

1909–1917: Maximum stage recorded March 24, 1917; minimum stage recorded during open water period, 0.80 foot July 17, 1911 (discharge 267 second-feet); a discharge of 231 second-feet was measured by current meter on January 23, 1914.

Ice.—Stage-discharge relation seriously affected by ice.

Regulation.—Nearest dam above station is at Rushford. As the flow is ample at all times for the power generated at that point, it is not held back during certain parts of the day, and the dam has no influence on the flow at Houston.

Accuracy.—Stage-discharge relation not permanent; change occurred in control section between June and September. Rating curve used October 1 to June 30 well defined between 500 and 10,500 second-feet. Daily discharge July 1 to Sept. 30 determined by shifting-control method. Daily discharges during remainder of period obtained by applying mean daily gage height to rating table except during period when stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Records fair except those for winter, which are subject to error.

Discharge measurements of Root River near Houston, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 19[a]	R. B. Kilgore	2.82	320	Apr. 28	S. B. Soulé	2.63	759
Feb. 21[a]	S. B. Soulé	3.12	282	June 12	....do	3.72	1,170
Mar. 28	....do	5.44	2,090	Sept. 27	R. B. Kilgore	2.08	416

[a] Made through complete ice cover.

Daily discharge, in second-feet, of Root River near Houston, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	468	468	474	335	300	306	1,370	888	933	2,230	602	407
2	437	468	503	335	300	296	1,270	978	1,170	1,920	602	437
3	468	468	471	330	300	310	1,170	1,020	1,070	1,580	567	379
4	437	468	471	330	290	290	1,120	933	978	1,370	602	407
5	437	468	468	330	296	290	1,070	843	888	1,270	602	407
6	437	437	465	335	300	315	1,020	790	1,220	1,270	567	407
7	407	468	468	325	290	325	978	716	1,580	1,320	567	437
8	437	602	462	325	285	345	933	716	1,750	1,320	567	500
9	437	638	462	325	285	335	888	676	1,920	1,320	602	533
10	437	638	410	325	285	370	790	638	1,480	1,170	567	468
11	437	602	405	325	285	400	790	933	1,270	1,270	567	437
12	407	567	396	325	280	435	757	602	1,120	1,580	567	437
13	468	567	390	320	280	535	716	567	1,530	1,420	567	437
14	468	500	385	320	280	580	676	567	1,120	1,370	533	468
15	468	500	380	320	280	580	676	567	1,070	1,220	533	437
16	437	567	375	320	280	515	638	533	978	1,070	533	407
17	437	567	375	320	280	480	638	533	933	1,020	500	407
18	437	533	370	320	280	470	978	533	888	933	500	437
19	437	567	360	320	280	430	978	567	843	888	500	437
20	500	500	355	315	280	516	1,070	567	790	843	500	500
21	468	500	350	315	280	600	978	676	757	790	468	468
22	468	500	350	310	280	675	933	716	757	978	468	468
23	437	500	350	310	305	2,230	888	790	2,360	843	533	437
24	437	500	345	310	280	15,000	843	757	5,900	790	468	407
25	533	437	345	305	310	8,000	843	716	7,530	757	437	437
26	500	500	345	305	310	4,740	790	676	5,980	716	468	437
27	500	533	345	305	305	3,000	757	676	4,050	716	468	407
28	500	533	340	305	305	2,180	716	638	3,160	676	437	407
29	500	500	340	305	....	1,750	790	638	3,250	638	437	437
30	500	500	340	305	....	1,530	790	638	3,080	602	437	437
31	500	....	340	305	....	1,420	....	757	....	638	437	....

NOTE.—Stage-discharge relation affected by ice Dec. 1 to Mar. 25.

Monthly discharge of Root River near Houston, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 1,560 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	533	407	459	0.294	0.34
November	638	437	520	.333	.37
December	503	340	395	.253	.29
January	335	305	318	.204	.24
February	310	280	289	.185	.19
March	15,000	280	1,580	1.01	1.16
April	1,370	638	897	.575	.64
May	1,020	533	696	.446	.51
June	7,530	757	2,020	1.29	1.44
July	2,230	602	1,110	.712	.82
August	602	437	523	.335	.39
September	533	379	438	.281	.31
The year	15,000	280	773	.496	6.70

NORTH BRANCH OF ROOT RIVER NEAR LANESBORO, MINN.

LOCATION.—In sec. 6, T. 103 N., R. 9 W., at first highway bridge 1 mile above junction of North and South branches, 3 miles north of Lanesboro, Fillmore County, and about 5 miles below mouth of a small creek that enters from the west.

DRAINAGE AREA.—647 square miles.

RECORDS AVAILABLE.—March 9, 1910, to September 30, 1914; and July 16, 1915, to September 30, 1917, when station was discontinued.

GAGE.—Chain gage on floor of bridge, downstream side, near right bank; read by Olaf Waage.

DISCHARGE MEASUREMENTS.—Made from the downstream side of the bridge, from the railroad bridge just above the junction with the South branch (at flood stages) or by wading just above the gage.

CHANNEL AND CONTROL.—Bed composed of sand and light gravel. A few hundred feet below the gage the channel is narrowed by a low island and there is a slight riffle that constitutes a control at low stages and is practically permanent. As there is more than 10 feet fall between the station and the mouth of the South Branch backwater from that stream is improbable. At a stage of 6 feet the river overflows into a former channel 1,000 feet back from the right bank. At extreme flood stages the right bank is overflowed to a width of a quarter of a mile.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.0 feet March 23 (discharge estimated, because of ice, about 12,000 second-feet); minimum discharge, during period river was frozen over, February 25–28, estimated at 90 second-feet.

1910–1917: Maximum stage recorded March 23, 1917; minimum open-water stage recorded, 1.71 feet July 4, 1911 (discharge, 38 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—Several miles above the station is a power plant that is run under a varying load for light and power, but inspection of the morning and evening gage heights indicates that the diurnal fluctuation at the gage is slight.

ACCURACY.—Stage-discharge relation changed during high water of March. Rating curve used before change well defined between 186 and 1,350 second-feet; curve used after change fairly well defined between 155 and 3,400 second-feet. Gage read to quarter tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for periods in which the stage-discharge relation was affected by backwater from ice for which it was ascertained by applying to the rating table mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Records fair except those for winter, which are subject to error.

Discharge measurements of North Branch Root River near Lanesboro, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 20[a]	R. B. Kilgore	2.73	113	Apr. 28	S. B. Soulé	2.56	307
Feb. 22[a]	S. B. Soulé	2.90	94	June 11	.....do	3.13	616
Mar. 27	.....do	4.01	1,120	Sept. 28	R. B. Kilgore	2.21	187

[a] Measurement made through complete ice cover.

Daily discharge, in second-feet, of North Branch of Root River near Lanesboro, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	141	186	190	135	110	115	585	475	925	1,040	215	135
2	151	175	180	135	110	110	420	530	678	710	240	128
3	154	172	190	135	110	110	475	502	558	530	194	142
4	164	151	180	135	110	110	475	448	448	448	197	155
5	164	228	185	130	110	110	448	370	420	448	191	164
6	138	192	175	130	105	135	420	325	678	502	240	158
7	146	175	175	130	105	115	395	285	1,080	558	271	173
8	133	247	185	130	105	135	370	257	1,580	710	264	188
9	149	320	185	130	105	125	325	268	1,210	558	240	176
10	154	293	78	125	105	135	285	240	1,000	448	232	158
11	141	282	120	125	105	100	264	226	745	370	226	161
12	151	268	160	125	100	135	246	232	1,250	530	212	173
13	162	254	160	125	100	160	257	226	1,210	780	226	158
14	192	221	155	120	100	245	268	212	710	558	206	155
15	146	164	155	120	100	170	246	206	395	502	206	148
16	150	181	150	120	100	185	229	194	305	395	191	138
17	181	192	150	120	100	165	257	182	305	395	182	130
18	154	261	145	120	100	190	278	191	325	348	173	122
19	162	133	145	120	95	180	305	226	305	305	161	135
20	141	192	145	115	95	180	348	250	285	285	150	161
21	175	198	145	115	95	130	395	305	232	250	155	179
22	154	231	145	115	95	2,260	420	502	197	236	150	173
23	167	189	145	115	95	10,500	370	448	850	271	155	158
24	175	203	140	115	95	3,400	325	370	6,040	285	164	142
25	195	186	140	115	90	2,260	325	305	3,280	257	158	140
26	189	192	140	110	90	1,520	325	348	2,590	229	150	152
27	192	203	135	110	90	925	285	305	1,380	209	145	135
28	209	198	135	110	90	780	285	305	1,830	200	140	132
29	195	209	135	110	....	710	305	325	1,780	218	128	122
30	192	154	135	110	....	645	348	370	1,580	222	138	115
31	192	....	135	110	....	615	....	645	....	236	143	....

NOTE.—Stage-discharge relation affected by ice Dec. 1 to Mar. 28. Gage not read Nov. 12; discharge interpolated.

Monthly discharge of North Branch of Root River near Lanesboro, Minn., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	209	133	165	0.255	0.29
November	320	133	208	.321	.36
December	190	78	153	.236	.27
January	135	110	121	.187	.22
February	110	90	100	.155	.16
March	10,500	100	860	1.33	1.53
April	585	229	343	.530	.59
May	645	182	325	.502	.58
June	6,040	197	1,140	1.76	1.96
July	1,040	200	420	.649	.75
August	271	128	189	.292	.34
September	188	115	150	.232	.26
The year	10,500	78	349	.539	7.31

WISCONSIN RIVER AT WHIRLPOOL RAPIDS, NEAR RHINELANDER, WIS.

LOCATION.—In sec. 4, T. 35 N., R. 8 E., Lincoln County, at head of Whirlpool Rapids, 1 mile below mouth of outlet of Crescent Lake (coming in from right), and about 3 miles downstream from power station of Rhinelander Power Co., 10 miles southwest of Rhinelander.

DRAINAGE AREA.—1,160 square miles (measured on map issued by Wisconsin Geological & Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—September 15, 1915, to September 30, 1917; December 1, 1905, to September 30, 1915, for station, about 3 miles upstream.

GAGE.—Stevens continuous water-stage recorder, on right bank, in wooden shelter, well and intake.

DISCHARGE MEASUREMENTS.—Made from a cable 150 feet upstream from gage.

CHANNEL AND CONTROL.—Bed of stream heavy gravel and rock. Banks medium high and not subject to overflow. Control is head of rapids, 100 feet downstream from gage; well defined and permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 4.15 feet at 10 a. m. April 25 (discharge, 2,900 second-feet); minimum stage recorded 0.86 foot at 8.30 p. m. August 19 (discharge, 232 second-feet).

1905–1917: Maximum stage recorded 5.61 at 10:00 p. m. April 22, 1916 (discharge 5,250 second-feet); minimum discharge recorded, at old station, zero during August and September, 1907, and June, 1908. Minimum flow caused almost entirely by regulation, and at the present station will never be zero discharge. Minimum discharge at new location, 1915–1917, 0.85 foot 5 p. m. August 20, 1916 (discharge 228 second-feet).

REGULATION.—Above the station are 14 reservoirs [1] which are operated by the Wisconsin Valley Improvement Co., for the purpose of regulating the flow in Wisconsin River. The aggregate capacity of these reservoirs is 2.8 billion cubic feet during the summer, and 3.6 billion cubic feet during the winter. Owing to the operation of these various storage reservoirs and the service reservoirs of three powerplants on river above this station, the flow at the station is not natural.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 212 and 5,410 second-feet. Recording gage not in operation October 17 to November 1, December 25 to March 9, and March 21–25. Daily discharge obtained by use of discharge integrator except for periods during which stage-discharge relation was affected by ice or gage was not in operation, for which it was obtained from discharge measurements, recording gage graph and observer's notes, and weather records and comparison of flow of Tomahawk River near Bradley and Wisconsin River at Merrill. Open-water records excellent, except those for periods when gage was not in operation, which may be considerably in error; winter records possibly poor.

Discharge measurements of Wisconsin River at Whirlpool Rapids, near Rhinelander, Wis., during the year ending Sept. 30, 1917.

[Made by R. B. Kilgore.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Dec. 30 [a]	4.32	1,130
Mar. 3 [a]	3.46	795
June 28	2.90	1,600

[a] Frazil and surface ice at control.

[1] Information concerning these reservoirs, based on maps and data furnished by A. A. Babcock, manager of the Wisconsin Valley Improvement Co., and data collected by the Engineering Department of the Railroad Commission of Wisconsin, is contained in U. S. Geol. Survey Water-Supply Paper 405, p. 127.

Daily discharge, in second feet, of Wisconsin River at Merrill, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	3,690	3,720	2,420	1,720	1,620	1,580	3,230	8,850	2,730	3,320	1,740	1,840
2	3,320	3,810	2,630	1,480	1,640	1,410	3,560	8,950	2,380	2,150	1,870	1,940
3	3,130	3,840	2,410	1,320	1,600	1,470	4,590	8,160	2,840	2,960	1,880	1,420
4	2,540	3,910	2,020	1,500	1,620	1,520	5,330	7,760	2,120	3,060	1,890	1,720
5	2,890	3,460	2,030	1,640	1,560	1,180	5,100	7,110	3,370	1,520	2,250	2,440
6	2,700	3,000	1,930	1,300	1,500	1,410	5,350	6,590	4,950	2,610	1,520	2,360
7	2,340	2,990	2,470	1,400	1,740	1,470	5,840	5,590	6,640	2,940	2,110	2,010
8	2,620	4,640	2,420	1,240	1,520	1,430	5,880	5,370	7,510	2,410	2,450	1,990
9	2,540	4,640	1,810	1,220	1,630	1,320	6,550	4,630	7,300	1,590	2,100	1,990
10	2,520	5,020	1,890	1,410	1,640	1,360	7,480	4,300	6,320	2,630	2,080	1,600
11	2,010	5,050	1,740	1,580	1,530	1,410	6,410	4,000	4,600	2,270	2,020	1,360
12	2,180	4,940	1,650	1,500	1,490	1,570	7,300	3,720	4,750	2,420	1,890	1,800
13	2,190	3,810	1,570	1,520	1,470	1,630	7,880	3,340	4,670	1,980	1,550	2,000
14	2,140	3,470	1,630	1,420	1,480	1,680	7,230	2,790	4,250	2,250	2,050	1,930
15	2,200	2,950	1,680	1,450	1,490	1,970	5,840	3,060	3,960	2,080	1,990	2,150
16	2,040	3,380	2,060	1,350	1,430	1,720	4,770	3,240	3,420	1,850	2,170	2,010
17	2,800	2,850	1,860	1,630	1,420	1,810	4,810	2,920	3,040	2,050	1,930	1,470
18	2,430	2,610	1,530	1,370	1,390	1,770	5,030	2,920	2,900	1,700	1,880	1,660
19	3,190	2,920	1,460	1,760	1,530	1,780	6,100	3,100	2,940	2,230	2,970	1,910
20	2,930	2,920	1,800	1,580	1,570	2,080	7,440	2,930	3,140	1,840	1,420	1,750
21	3,490	3,430	1,520	1,370	1,630	2,520	9,480	2,600	3,190	2,050	1,580	1,830
22	3,140	2,880	1,450	1,350	1,590	2,090	9,920	2,750	2,840	1,760	1,700	1,770
23	2,690	3,240	1,480	1,440	1,650	2,490	9,140	2,980	2,860	1,350	1,830	1,920
24	3,320	2,600	1,470	1,620	1,530	2,690	7,820	2,790	2,690	1,920	2,040	1,240
25	3,120	2,180	1,740	1,630	1,590	2,760	7,310	2,680	2,460	1,780	1,830	1,250
26	3,570	2,510	1,580	1,510	1,460	2,310	7,540	2,540	3,770	1,770	1,720	1,990
27	3,420	2,990	1,450	1,560	1,590	2,460	6,520	2,460	3,810	1,660	2,190	1,720
28	3,770	2,240	1,980	1,560	1,560	2,540	7,040	1,460	3,370	1,920	1,900	1,570
29	3,450	2,130	2,020	1,320	......	2,270	7,440	2,090	3,420	1,850	1,990	1,850
30	3,870	2,260	1,720	1,470	......	2,480	8,180	2,200	3,190	1,740	1,950	2,000
31	3,550	......	1,880	1,600	......	3,120	......	2,300	......	1,750	2,040	......

NOTE.—Stage-discharge relation affected by ice Dec. 14 to Apr. 4. Discharge for Oct. 23, Nov. 14, Dec. 18, 20–23, 29, Jan. 4–6, Feb. 17, 18, Aug. 13–18, based on gage heights for less than 24-hour period.

Monthly discharge of Wisconsin River at Merrill, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 2,630 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	3,870	2,010	2,900	1.10	1.27
November	5,050	2,130	3,350	1.27	1.42
December	2,630	1,450	1,850	.703	.81
January	1,760	1,220	1,480	.563	.65
February	1,740	1,420	1,550	.589	.61
March	3,120	1,180	1,910	.726	.84
April	9,920	3,230	6,540	2.49	2.78
May	8,950	1,460	4,070	1.55	1.79
June	7,510	2,120	3,850	1.46	1.63
July	3,320	1,350	2,110	.802	.92
August	2,970	1,420	1,950	.741	.85
September	2,440	1,240	1,820	.692	.77
The year	9,920	1,180	2,780	1.06	14.34

WISCONSIN RIVER NEAR NEKOOSA, WIS.

LOCATION.—In sec. 15, T. 21 N., R. 5 E., 1½ miles below Nekoosa, Wood County. Tenmile Creek enters from left about 4 miles below station, and Big Roche a Cri Creek, also from left, about 38 miles below.

DRAINAGE AREA.—5,500 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—May 21, 1914, to September 30, 1917.

GAGE.—Stevens water-stage recorder installed July 18, 1916, in wooden shelter on right bank; prior to that date Gurley water-stage recorder at same location. Gage attended by Henry Mans.

DISCHARGE MEASUREMENTS.—Made from cable a short distance upstream from gage.

CHANNEL AND CONTROL.—Gravel; clean; practically permanent. Banks are high and are rarely overflowed.

EXTREMES OF DISCHARGE.—Maximum stage during year, 10.02 feet at 10 p. m. April 5 (discharge, 24,700 second-feet); minimum discharge, 835 second-feet January 10.

1914–1917: Maximum stage, as determined by levels run to high-water marks after water had receded, about 15.3 feet during the flood of June 6 to 9, 1914 (discharge, 54,600 second-feet); minimum stage recorded, 0.45 foot at 11 a. m. October 7, 1915 (discharge, 595 second-feet). Minimum flow is due to regulation.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—No storage reservoirs discharging into Wisconsin River between Nekoosa and Merrill. See "Regulation" in station description of Wisconsin River at Merrill (p. 111). Between Nekoosa and Merrill are 12 dams operated for power.

ACCURACY.—Stage-discharge relation practically permanent, except as affected by ice. Rating curve well defined between 1,160 and 52,100 second-feet. Operation of water-stage recorder satisfactory, except October 1 and November 22. Daily discharge ascertained by use of discharge integrator, except December 15 to March 29, for which it was obtained by applying to rating table, mean daily gage height corrected for effect of ice by means of discharge measurements, recording gage records, observer's notes, and weather records. Open-water records excellent; winter records fair.

Discharge measurements of Wisconsin River near Nekoosa, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 30[a]	E. L. Williams	3.55	1,580	Mar. 5[a]	E. L. Williams	3.17	1,520
Feb. 1[a]	do	3.56	2,220	July 10	R. B. Kilgore	2.51	3,860

[a] Complete ice cover.

Daily discharge, in second-feet, of Wisconsin River near Nekoosa, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	6,410	7,130	4,400	2,850	2,630	1,800	12,600	16,500	3,290	4,450	3,150	2,760
2	6,120	6,740	4,300	2,380	2,760	2,500	14,400	18,700	4,180	5,180	3,380	2,600
3	5,200	6,300	3,980	2,500	2,650	1,960	15,800	19,000	4,480	4,570	3,040	3,220
4	4,890	6,480	4,070	2,450	2,790	2,450	17,300	17,500	4,600	3,430	2,500	2,630
5	4,750	6,530	4,220	2,440	3,100	2,060	21,200	15,000	4,680	4,370	2,460	2,800
6	3,960	6,580	4,210	2,300	2,320	2,070	23,600	12,900	5,060	4,240	2,860	2,450
7	3,960	6,380	3,620	1,720	2,550	2,050	22,400	11,000	8,480	3,450	1,740	2,920
8	4,120	5,430	3,560	2,330	2,880	2,400	20,400	9,700	13,100	3,060	2,380	3,730
9	3,780	6,030	3,640	1,430	2,820	3,160	20,200	8,470	18,100	3,890	3,490	3,700
10	3,460	10,200	2,380	1,880	2,810	2,490	18,490	7,800	18,100	4,110	4,020	2,870
11	3,910	11,000	3,800	1,600	2,850	2,380	17,100	6,960	15,000	4,620	3,700	2,440
12	4,140	10,300	3,240	2,160	2,500	2,100	16,300	6,700	10,800	3,030	3,710	2,780
13	4,190	8,900	3,080	1,850	1,760	2,040	16,800	6,380	8,410	3,010	3,310	2,790
14	3,490	7,120	2,500	2,180	2,490	2,470	17,700	5,750	8,170	3,730	4,580	2,820
15	3,740	5,370	3,820	2,880	2,730	2,870	15,700	5,180	7,330	3,280	5,900	2,880
16	3,060	5,130	3,690	1,690	2,650	3,220	13,700	4,770	6,800	3,050	4,940	3,240
17	2,910	4,970	3,780	2,170	2,330	2,670	10,600	4,790	5,290	3,250	5,400	3,010
18	3,800	4,880	3,650	2,250	2,670	2,720	9,440	4,800	5,700	3,550	4,390	3,160
19	3,490	5,340	3,440	2,370	2,120	3,300	10,500	4,570	4,700	3,370	3,740	3,030
20	4,290	5,430	2,980	1,940	1,670	2,550	13,700	4,580	4,960	3,420	3,400	2,680
21	4,300	4,920	3,370	2,250	2,270	2,760	16,100	5,260	4,400	2,640	3,190	2,520
22	4,590	4,970	3,370	2,060	2,530	3,090	18,000	4,970	4,640	2,410	3,280	2,160
23	5,050	5,340	3,170	1,960	2,120	3,250	19,400	4,670	4,550	2,860	2,970	1,740
24	4,840	5,260	3,130	2,510	2,310	3,800	18,400	4,480	4,210	2,790	2,970	2,500
25	4,880	4,300	2,580	2,220	2,830	4,110	15,300	4,610	4,470	3,710	3,120	2,360
26	5,210	3,690	3,910	2,450	2,310	6,060	13,500	4,550	4,380	3,350	2,450	2,400
27	5,280	4,440	2,430	2,690	1,530	7,050	12,600	4,210	4,700	2,760	2,700	2,430
28	6,250	3,750	1,780	2,480	2,040	8,840	12,700	4,320	5,060	2,900	2,270	2,660
29	6,330	5,040	2,730	2,710	....	9,510	12,900	3,840	5,330	2,450	2,840	2,530
30	6,340	4,670	2,530	1,550	....	10,000	14,500	3,560	4,900	2,330	2,960	2,530
31	6,560	....	2,560	2,090	....	11,600	....	3,600	....	2,430	2,910	....

NOTE.—Stage-discharge relation affected by ice Dec. 15 to Mar. 29. Gage not operating satisfactorily Oct. 1, Nov. 22; discharge partly estimated.

Monthly discharge of Wisconsin River near Nekoosa, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 5,500 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	6,560	2,910	4,620	0.840	0.97
November	11,000	3,690	6,110	1.11	1.24
December	4,400	1,780	3,360	.611	.70
January	2,880	1,430	2,220	.404	.47
February	3,100	1,530	2,450	.445	.46
March	11,600	1,800	3,830	.696	.80
April	23,600	9,440	16,100	2.93	3.27
May	19,000	3,560	7,710	1.40	1.61
June	18,100	3,290	6,930	1.26	1.41
July	5,180	2,330	3,430	.624	.72
August	5,900	1,740	3,350	.609	.70
September	3,730	1,740	2,740	.498	.56
The year	23,600	1,430	5,290	.961	12.91

WISCONSIN RIVER AT MUSCODA, WIS.

LOCATION.—In sec. 1, T. 8 N., R. 1 W., at highway bridge 1 mile north of Muscoda, Grant County. Eagle Mill Creek enters from right about half a mile below station, and Underwood Creek from left about 4½ miles above.

DRAINAGE AREA.—10,300 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—December 21, 1902, to December 31, 1903; December 4, 1913, to September 30, 1917. Gage heights November 1, 1908, to December 31, 1912, published in United States Weather Bureau bulletin, Daily River Stages, parts 9, 10, and 11.

GAGE.—Chain gage fastened to hand railing on upstream side of bridge; read by William Hessler. Elevation of zero of present gage about 12.62 feet above that of gage maintained December 20, 1902, to December 3, 1913, elevation of gage during period November, 1908, to December 3, 1913, as read and published by United States Weather Bureau was about the same as that of present gage, sea-level elevation of which is 666.2 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 6.95 feet April 11 (discharge 32,800 second-feet); minimum discharge estimated 3,400 second-feet February 12.

1903 and 1914–1917: Maximum stage recorded, 22.70 feet September 23, 1903, corresponding to 10.1 feet for present gage datum (discharge, about 60,500 second-feet); minimum stage recorded 0.7 foot December 2, 1914, and 5 p. m. July 24, 1915 (discharge about 3,140 second-feet).

According to the records of the United States Weather Bureau[1] (see note under "Gage") on June 11, 1881, the river reached a stage of 11.1 feet and during August, 1868, zero on gage; discharge not computed owing to possible changes in channel and datum of gage.

REGULATION.—Nearest power plant above station is at Prairie du Sac, about 40 miles distant; since the last part of 1915 considerable diurnal fluctuation has been observed at the gage. Owing to regulation by storage in the headwaters the flow at this station is not natural.

ACCURACY.—Stage-discharge relation not permanent; affected by ice. Rating curve used during 1917, fairly well defined between 5,200 and 45,000 second-feet. Gage read to quarter-tenths twice a day. Daily discharge ascertained by applying mean daily gage height to rating table, except for periods when stage-discharge relation was affected by ice, for which it was obtained by applying to rating table mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good, except for extreme high and low stages, for which they are fair; winter records roughly approximate.

Discharge measurements of Wisconsin River at Muscoda, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Jan. 6[a]	E. L. Williams	3.30	4,390
Feb. 15[a]	Hoyt and Williams	3.25	4,060
July 31	Kilgore and Entringer	2.11	7,230

[a] Complete ice cover.

[1] U. S. Dept. Agr., Daily river stages, pt. 10, p. 98.

Daily discharge, in second-feet, of Wisconsin River at Muscoda, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	8,140	11,800	9,700	4,450	3,790	4,220	23,100	20,300	9,700	14,800	7,040	4,940
2	8,140	10,100	10,500	4,450	4,000	4,000	23,100	19,700	9,300	13,000	6,700	4,940
3	8,900	8,520	10,500	4,450	3,790	3,590	19,700	19,700	9,700	12,200	6,380	4,940
4	10,100	10,500	8,900	4,450	3,790	3,590	21,400	21,900	10,900	12,200	6,060	5,200
5	12,200	11,800	7,760	4,450	3,790	3,590	23,100	22,500	10,500	12,600	6,380	5,480
6	9,300	11,300	8,140	4,450	4,000	4,000	24,400	24,400	10,100	13,000	5,480	6,060
7	7,400	10,500	7,760	4,450	4,000	4,450	25,700	25,100	12,200	11,800	6,380	6,060
8	7,760	10,100	8,140	3,790	4,000	4,940	27,100	26,400	14,400	8,900	7,040	6,380
9	7,400	10,500	7,760	4,220	3,790	4,940	30,000	25,700	13,000	8,900	6,700	6,700
10	6,700	10,900	7,400	4,220	4,000	4,940	31,600	19,700	13,000	7,760	6,700	6,060
11	6,700	10,900	7,760	4,450	3,790	6,380	31,600	16,700	14,400	8,140	6,060	6,380
12	6,700	8,900	8,520	4,220	3,400	7,040	30,800	14,800	19,700	8,520	6,060	6,060
13	6,700	10,100	7,040	3,790	4,000	7,040	30,000	14,800	21,900	8,520	5,480	6,380
14	6,380	13,500	5,480	4,450	4,000	7,760	27,800	12,600	25,100	7,400	5,760	6,700
15	5,200	14,800	5,200	3,590	4,000	7,040	25,700	10,100	26,400	7,400	7,040	6,060
16	5,200	13,500	5,200	4,000	4,000	8,900	20,800	12,200	20,800	6,380	9,300	6,380
17	5,480	8,900	4,940	4,220	4,000	9,700	21,900	12,200	14,400	6,700	7,400	5,760
18	6,060	7,400	4,940	4,450	3,790	7,400	23,100	11,300	12,600	7,400	5,760	6,060
19	7,400	9,700	4,940	4,450	3,590	7,040	23,800	10,500	14,400	7,400	6,380	6,380
20	7,400	9,700	4,940	4,000	4,000	8,140	19,700	8,900	14,400	7,040	8,140	6,700
21	7,760	10,500	4,940	4,000	4,220	10,500	18,700	9,700	10,100	6,700	11,300	6,700
22	6,700	10,900	4,940	3,790	4,000	13,000	18,200	11,800	8,140	7,760	8,520	6,060
23	6,060	11,300	4,940	4,000	4,000	15,300	18,700	10,900	10,900	8,520	6,700	6,380
24	7,040	11,300	4,690	4,220	3,790	17,700	21,400	8,900	13,000	10,500	6,700	5,200
25	8,900	8,140	4,690	4,450	4,000	17,200	23,100	9,300	20,300	9,300	6,700	5,760
26	9,700	9,300	4,690	4,220	3,590	17,200	25,100	10,900	17,700	7,760	6,700	6,060
27	9,300	8,140	4,690	4,000	3,790	17,700	26,400	11,300	13,900	7,760	6,060	5,480
28	10,100	8,520	4,690	4,000	4,000	17,200	25,700	10,500	1[illegible],500	7,040	6,380	5,480
29	10,100	8,520	4,450	3,590	....	17,700	25,700	10,900	14,800	7,040	5,760	4,940
30	8,900	8,520	4,450	4,220	....	20,800	20,800	10,100	14,400	6,380	6,060	5,200
31	10,900	....	4,450	4,000	....	21,400	....	9,300	....	7,040	5,200	....

NOTE.—Stage-discharge relation affected by ice, Dec. 15 to Mar. 25.

Monthly discharge of Wisconsin River at Muscoda, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 10,300 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	12,200	5,200	7,890	0.766	0.88
November	14,800	7,400	10,300	1.00	1.12
December	10,500	4,450	6,360	.617	.71
January	4,450	3,590	4,180	.406	.47
February	4,220	3,400	3,890	.378	.39
March	21,400	3,590	9,820	.953	1.10
April	31,600	18,200	24,300	2.36	2.63
May	26,400	8,900	14,900	1.45	1.67
June	26,400	8,140	14,500	1.41	1.57
July	14,800	6,380	8,900	.864	1.00
August	11,300	5,200	6,720	.652	.75
September	6,700	4,940	5,900	.573	.64
The year	31,600	3,400	9,810	.952	12.93

TOMAHAWK RIVER NEAR BRADLEY, WIS.

LOCATION.—In sec. 16, T. 36 N., R. 6 E., 2 miles west of Cassion, 4 miles north of Bradley, Oneida County, 4 miles downstream from mouth of Bearskin Creek (coming in from right), and 8 miles above mouth of river.

DRAINAGE AREA.—422 square miles.

RECORDS AVAILABLE.—September 18, 1914, to September 30, 1917.

GAGE.—Chain gage fastened to cantilever arm on the right bank; read by Frank Sutherland.

DISCHARGE MEASUREMENTS.—Made from cable half a mile below gage.

CHANNEL AND CONTROL.—Bed at gage and a short distance below, sandy and likely to shift. Control is formed by rapids about 2,000 feet below gage. Bed at cable section heavy gravel; permanent. When a head of 15 feet is maintained in Rice Lake storage dam, in sections 4 and 9, T. 35 N., R. 6 E., backwater will extend halfway up the rapids which are below the gage, and may affect the discharge relation. The maximum head maintained during year at the reservoir was 13 feet 1 inch, during July 21, which apparently did not affect the control for the gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 4.31 feet at 7.25 a. m. April 22 (discharge, 927 second-feet); minimum stage, 1.72 feet at 6.45 a. m. September 12 (discharge, 229 second-feet).

1914–1917: Maximum stage recorded, 6.88 feet April 24, 1916 (discharge, 2,190 second-feet); minimum stage recorded, September 12, 1917.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—The following reservoirs are maintained upstream from the station for the purpose of regulating the flow in the Wisconsin River.

Dams and reservoirs on Tomahawk River.

Name.	Location of reservoir.	Location of dam.	Area of reservoir.	Drainage area.	Capacity (millions of cubic feet).	
					Summer.	Winter.
			Sq. mi.	*Sq. mi.*		
Squirrel...	T. 39 N., R. 5 E.......	Sec. 30, T. 39 N., R. 5 E.	3.00	17.07	152	152
Minocqua.	Tps. 38–40 N., Rs. 6–7 E.	Sec. 10, T. 39 N., R. 6 E.	11.31	81.60	291	651
Total.	....	....	14.31	98.67	443	803

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve well defined between 240 and 1,970 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except for periods in which stage-discharge relation was affected by ice, for which it was obtained by applying to rating table mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good except for extremely low stages for which they are fair; winter records fair.

Discharge measurements of Tomahawk River near Bradley, Wis., during the year ending Sept. 30, 1917.

[Made by R. B. Kilgore.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 18a............	3.10	378	Mar. 7a............	3.32	306
Feb. 1a............	3.02	340	June 27............	3.62	606

a Complete ice cover.

Daily discharge, in second-feet, of Tomahawk River near Bradley, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	516	604	566	350	340	295	640	815	460	604	243	265
2	488	604	589	365	340	310	650	850	474	574	240	258
3	474	589	546	360	345	325	610	850	460	530	246	252
4	460	559	502	355	360	320	575	815	460	502	248	245
5	447	544	488	350	380	320	582	780	488	474	273	246
6	434	516	516	340	365	310	589	746	516	488	278	246
7	434	516	488	340	350	305	596	713	619	516	295	263
8	421	589	474	345	350	315	604	681	697	516	322	242
9	421	666	474	350	355	325	619	650	713	502	328	237
10	421	681	516	355	360	330	681	619	713	474	322	234
11	421	681	502	350	360	340	798	589	666	460	308	232
12	421	666	502	340	360	350	780	559	604	474	293	232
13	474	559	516	325	360	360	763	559	574	474	285	268
14	488	295	502	310	345	380	746	516	544	460	290	345
15	488	396	490	300	335	395	681	488	530	434	293	384
16	502	604	475	290	340	380	650	474	502	408	320	384
17	574	666	445	320	345	370	634	460	488	396	316	349
18	589	666	420	350	350	370	681	460	516	372	300	328
19	589	604	410	360	350	370	763	474	544	338	300	336
20	589	574	395	375	340	365	850	488	544	332	290	324
21	589	559	385	350	330	360	923	488	544	318	275	320
22	574	502	385	330	330	385	923	474	530	300	268	314
23	559	502	370	340	330	410	923	447	544	293	268	310
24	544	502	370	345	330	410	886	421	574	293	271	304
25	589	475	370	340	330	415	291	408	634	293	271	304
26	619	475	370	330	340	400	798	396	681	282	278	349
27	619	460	370	345	345	390	746	384	681	271	308	384
28	619	460	370	355	320	480	730	372	681	261	326	366
29	619	502	370	350	....	565	730	365	681	255	308	384
30	604	544	360	340	....	595	798	363	650	249	284	384
31	604	....	345	340	....	625	....	408	....	246	268	....

NOTE.—Stage-discharge relation affected by ice Nov. 25-27 and Dec. 15 to Apr. 5. Gage not read, discharge interpolated, Nov. 29, Dec. 1, 3, and Apr. 7.

Monthly discharge of Tomahawk River near Bradley, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 422 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	619	421	522	1.24	1.43
November	681	295	552	1.31	1.46
December	589	345	448	1.06	1.22
January	375	290	342	.810	.93
February	380	320	346	.820	.86
March	625	295	383	.908	1.05
April	923	291	708	1.68	1.87
May	850	363	552	1.31	1.51
June	713	460	577	1.37	1.53
July	604	246	400	.948	1.09
August	328	240	2-7	.680	.78
September	396	232	303	.718	.80
The year	923	232	452	1.07	14.52

PRAIRIE RIVER NEAR MERRILL, WIS.

LOCATION.—On line between secs. 20 and 29, T. 32 N., R. 7 E., at highway bridge 4½ miles northeast of Merrill, Lincoln County, and about 5½ miles above mouth of river. Haymeadow Creek enters from left about 5 miles above station.

DRAINAGE AREA.—164 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—January 18, 1914, to September 30, 1917.

GAGE.—Chain gage attached to upstream side of bridge; read by Mrs. Meta Krause.

DISCHARGE MEASUREMENTS.—At low stages made by wading; at medium and high stages from downstream side of bridge to which gage is attached.

Channel and control.—Bed composed of gravel; clean and free from vegetation. Left bank high, not subject to overflow; both banks wooded. Control not well defined.

Extremes of discharge.—Maximum stage recorded during year, 4.0 feet June 8 (discharge, 870 second-feet); minimum discharge about 80 second-feet January 11, 12, and 16.

1914–1917: Maximum stage recorded, 6.1 feet April 22, 1916 (discharge, 2,290 second-feet); minimum discharge, 72 second-feet, by discharge measurement January 4, 1915. Absolute minimum occurred during winter period 1914–15, and was probably somewhat less than 72 second-feet.

Ice.—Stage-discharge relation seriously affected by ice.

Regulation.—None.

Accuracy.—Stage-discharge relation permanent. Rating curve well defined between 103 and 2,200 second-feet. Gage read to half-tenths once a day. Daily discharge ascertained by applying daily gage height to rating table, except for periods in which stage-discharge relation was affected by ice, for which it was obtained by applying to rating table mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records excellent; winter records good.

Discharge measurements of Prairie River near Merrill, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 28[a]	E. L. Williams	2.10	88	Mar. 2[a]	E. L. Williams	1.92	91
Jan. 30[a]	do	1.94	86	July 4	R. B. Kilgore	1.97	132

[a] Control partly frozen over.

Daily discharge, in second-feet, of Prairie River near Merrill, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	366	384	148	85	85	90	313	614	159	172	106	110
2	278	366	133	85	90	90	402	574	159	172	101	110
3	244	278	133	85	90	90	535	535	184	133	93	115
4	212	244	137	85	90	90	655	496	313	122	93	110
5	184	212	137	90	90	95	244	440	348	118	184	159
6	172	184	172	85	90	90	421	384	614	128	184	184
7	159	159	159	85	90	95	535	348	825	122	184	184
8	148	458	148	85	95	95	313	296	870	128	212	159
9	159	458	137	90	95	100	458	278	825	128	212	148
10	148	496	125	85	90	95	614	278	870	118	184	148
11	148	384	120	80	90	100	614	244	825	118	159	159
12	137	348	115	80	90	95	781	184	870	128	137	159
13	159	313	110	85	90	95	781	212	614	128	133	159
14	159	244	110	85	90	95	655	198	458	118	122	159
15	159	261	105	85	90	95	496	184	278	115	118	159
16	159	278	105	80	95	100	384	184	212	118	115	137
17	184	212	105	85	95	95	348	184	184	110	106	128
18	198	212	100	85	95	95	384	184	198	110	106	122
19	198	212	100	85	95	100	458	244	184	110	110	122
20	184	184	95	85	95	110	535	278	184	110	115	122
21	198	159	95	85	90	110	614	278	184	106	110	106
22	198	159	95	85	90	130	655	244	159	101	110	106
23	198	159	90	85	90	135	696	228	159	101	106	103
24	212	184	90	90	90	155	535	212	159	97	110	103
25	212	160	90	90	90	159	458	184	212	91	110	103
26	212	170	90	90	90	184	440	172	244	89	115	106
27	228	175	90	85	90	184	421	159	228	93	122	106
28	244	180	90	85	90	184	496	137	212	103	128	110
29	313	184	90	85		184	574	137	212	103	133	106
30	348	159	90	85		212	574	159	184	106	122	103
31	402		95	85		278		159		103	115	

Note.—Stage-discharge relation affected by ice Nov. 25–28 and Dec. 10 to Mar. 24.

Monthly discharge of Prairie River near Merrill, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 164 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	402	137	210	1.28	1.48
November	496	159	253	1.54	1.72
December	172	90	113	.689	.79
January	90	80	85.3	.520	.60
February	95	85	91.1	.555	.58
March	278	90	123	.750	.86
April	781	244	513	3.13	3.49
May	614	137	271	1.65	1.90
June	870	159	371	2.26	2.52
July	172	89	116	.707	.82
August	212	98	131	.799	.92
September	184	103	130	.793	.88
The year	870	80	200	1.22	16.56

EAU CLAIRE RIVER AT KELLY, WIS.

LOCATION.—In sec. 13, T. 28 N., R. 8 E., at highway bridge three-quarters of a mile below Kelly, Marathon County, about a mile above mouth of Big Sandy Creek, which enters from right, and 4½ miles above mouth of river.

DRAINAGE AREA.—326 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—January 1, 1914, to September 30, 1917.

GAGE.—Chain gage fastened to downstream side of highway bridge; read by W. Woolsey.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading below bridge.

CHANNEL AND CONTROL.—Bed composed of heavy gravel and rock; gage is in the rapids which form the control. Banks medium high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.22 feet at 10 a. m. April 4 (discharge, 1,310 second-feet); minimum discharge estimated 50 second-feet for several days in January.

1914–1917: Maximum stage recorded, 5.1 feet April 22 and 23, 1916 (discharge, 3,270 second-feet); mimimum open-water stage recorded, 0.45 foot, August 13, 14, 15, Oct. 2 and 3, 1914 (discharge, about 40 second-feet). Discharge January 14, 17, and 18, 1916, estimated at 40 second-feet; minimum for winter period probably somewhat below this figure.

ACCURACY.—Stage-discharge relation permanent, except as affected by ice. Rating curve well defined between 71 and 3,150 second-feet. Gage read to quarter tenths twice daily except Sundays. Daily discharge ascertained by applying mean daily gage height to rating table, except for periods in which stage-discharge relation was affected by ice, for which it was obtained by applying to rating table mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Discharge for practically all Sundays interpolated. Open-water records good; winter records fair.

Discharge measurements of Eau Claire River at Kelly, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 29[a]	E. L. Williams	1.36	71	Mar. 3[a]	E. L. Williams	1.33	67
Jan. 31[a]	.....do	1.36	68	July 2	R. B. Kilgore	1.25	199

[a] Almost complete ice cover.

Daily discharge, in second-feet, of Eau Claire River at Kelly, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	358	499	210	60	65	70	670	990	193	176	102	93
2	300	443	204	60	65	70	677	990	213	193	114	91
3	252	390	196	60	70	65	990	862	228	171	104	94
4	227	340	188	65	70	65	1,290	677	244	139	93	102
5	182	340	155	65	70	65	1,290	587	263	139	94	142
6	199	340	199	65	65	70	1,210	488	416	147	96	252
7	185	340	216	55	65	70	1,210	390	1,130	139	114	204
8	176	365	213	55	65	70	1,070	340	1,210	147	210	177
9	168	647	216	55	65	70	925	320	1,210	155	213	153
10	132	647	183	50	70	70	800	300	914	139	193	129
11	152	617	150	50	70	70	862	267	617	129	158	129
12	155	458	171	50	70	70	862	250	528	132	300	114
13	158	300	155	50	70	70	769	236	340	129	443	129
14	158	284	155	55	70	75	617	221	300	129	390	145
15	144	255	140	55	80	75	530	221	255	116	210	145
16	129	284	130	50	80	80	443	210	238	104	168	150
17	158	267	115	50	70	80	416	204	216	129	150	155
18	160	261	115	55	80	80	443	199	193	104	129	129
19	182	236	105	55	85	80	617	207	188	104	116	116
20	179	210	105	55	85	85	738	222	185	94	104	116
21	224	224	100	50	80	85	990	238	165	104	104	106
22	224	216	95	50	80	95	990	235	150	116	112	104
23	224	221	95	50	80	110	990	227	155	129	116	94
24	235	210	85	50	80	110	862	216	163	119	100	85
25	238	188	80	50	80	160	738	179	171	104	93	95
26	340	202	80	50	85	215	647	182	177	93	106	89
27	390	215	75	55	80	325	617	222	179	93	119	93
28	443	207	75	55	80	310	708	261	171	85	124	85
29	457	207	70	60	....	285	816	250	168	85	104	85
30	471	182	70	70	....	380	925	196	158	85	89	85
31	528	....	70	70	....	660	....	179	....	87	85	....

NOTE.—Stage-discharge relation affected by ice Dec. 13, to Apr. 2. No gage readings Oct. 1, 8, 15, 22, 29, Nov. 5, 12, 19, 26, Dec. 3, 10, 17, 24, Apr. 8, 15, 22, 29, May 6, 13, 20, 27, June 3, 10, 17, 24, July 1, 8, 15, 22, 29, Aug. 5, 12, 19, 26, Sept. 2, 9, 16, 23, 30; discharge interpolated.

Monthly discharge of Eau Claire River at Kelly, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 326 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	528	129	243	0.745	0.86
November	647	182	320	.982	1.10
December	216	70	136	.417	.48
January	70	50	55.6	.171	.20
February	85	65	74.1	.227	.24
March	660	65	135	.414	.48
April	1,290	416	824	2.53	2.82
May	990	179	341	1.05	1.21
June	1,210	150	358	1.10	1.23
July	193	85	123	.377	.43
August	443	85	150	.460	.53
September	252	85	123	.377	.42
The year	1,290	50	240	.736	10.00

BIG EAU PLEINE RIVER NEAR STRATFORD, WIS.

LOCATION.—In sec. 13, T. 27 N., R. 3 E., at highway bridge at a place known locally as Weber Farm, about 2 miles north of Stratford, Marathon County, about 1 mile above Chicago & North Western Railway bridge. Dill Creek enters from right about 5 miles above station.

DRAINAGE AREA.—223 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—July 24, 1914, to September 30, 1917.

GAGE.—Sloping gage, reading from 1.0 to 15.6 feet, on right bank of the river, and vertical staff gage, reading from 15 to 18 feet, at upper end of sloping gage; read by Christian Weber.

DISCHARGE MEASUREMENTS.—Made by wading about 1,000 feet below gage or from the highway bridge.

CHANNEL AND CONTROL.—Bed composed of heavy gravel and rock; control at head of rapids 400 feet below gage. Both banks at gage are high and will be overflowed only at stage of about 15 feet and above.

EXTREMES OF DISCHARGE.—Maximum stage recorded during open-water period of year 7.42 feet at 6.30 a. m. April 4 (discharge, 3,670 second-feet); minimum open-water discharge, 11 second-feet December 22–30.

1914–1917: Maximum recorded stage 8.85 feet at 6 p. m. April 21, 1916 (discharge, 5,540 second-feet); minimum discharge, 3.0 second-feet, by current-meter measurement February 5, 1915. The flood of June, 1914, reached a maximum height of 20.7 feet as determined by levels run to high-water marks.

ACCURACY.—Stage-discharge relation practically permanent, except as affected by ice. Rating curve fairly well defined between 5 and 4,000 second-feet; gage read to quarter-tenths twice daily. Daily discharge obtained by applying mean daily gage height to rating table; estimated December 5–10, 31 and April 1–3 when stage-discharge relation was affected by ice. High-stage records good; records for medium and low stage fair.

Discharge measurements of Big Eau Pleine River near Stratford, Wis., during the year ending Sept. 30, 1917.

[Made by R. B. Kilgore.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 7	6.42	2,550
Aug. 24	1.70	20

Daily discharge, in second-feet, of Big Eau Pleine River near Stratford, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	162	280	57	3,000	1,110	47	25	18	12
2	120	223	49	3,000	840	60	27	31	12
3	81	192	49	3,000	470	63	19	27	12
4	61	403	49	3,090	327	69	17	19	12
5	57	310	45	1,810	241	310	15	55	24
6	57	230	45	1,810	182	642	18	83	25
7	57	188	45	1,810	145	2,210	22	55	22
8	49	1,260	45	1,330	123	1,490	19	195	19
9	49	1,570	45	1,040	105	720	17	134	17
10	49	780	43	840	83	382	15	60	15
11	49	518	34	1,110	75	215	17	44	15
12	49	310	28	840	60	175	22	31	13
13	55	230	22	694	55	112	19	44	15
14	57	162	22	470	47	75	17	33	15
15	57	162	22	327	40	60	15	27	25
16	49	132	18	260	40	44	15	24	22
17	49	103	18	247	33	36	15	19	18
18	49	87	18	327	31	33	15	18	18
19	40	77	14	694	36	31	19	22	15
20	40	77	14	1,040	40	27	27	40	15
21	40	73	14	1,040	44	25	19	31	15
22	40	67	11	780	63	22	24	24	13
23	40	73	11	494	63	22	182	22	12
24	40	98	11	344	55	22	123	18	12
25	87	81	11	295	50	27	55	18	12
26	272	57	11	269	33	31	31	18	12
27	205	55	11	566	31	27	24	17	12
28	167	55	11	694	29	22	18	15	12
29	180	57	11	780	25	22	17	15	12
30	239	67	11	1,110	25	18	13	15	12
31	217	....	10	....	36	....	12	12	....

Monthly discharge of Big Eau Pleine River near Stratford, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 223 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	272	40	89.1	0.400	0.46
November	1,570	55	266	1.19	1.33
December	57	10	26.8	.120	.14
April	3,090	247	1,100	4.93	5.50
May	1,110	25	146	.655	.76
June	2,210	18	235	1.05	1.17
July	182	12	28.8	.129	.15
August	195	12	38.5	.173	.20
September	25	12	15.5	.070	.08

PLOVER RIVER NEAR STEVENS POINT, WIS.

LOCATION.—In sec. 1, T. 24 N., R. 8 E., Portage County, at Fast Waters highway bridge, 5 miles northeast of Stevens Point and 7 miles above mouth of river.

DRAINAGE AREA.—136 square miles.

RECORDS AVAILABLE.—January 5, 1914, to September 30, 1917.

GAGE.—Metal vertical staff gage bolted to left abutment, downstream side of bridge; read by C. A. Van Order.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of heavy gravel and small rock; permanent and free from vegetation. At high stages both banks will be overflowed around the bridge. Control not well defined but is probably small rapids below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.55 feet at 8 a. m. May 1 (discharge, 452 second-feet); minimum discharge estimated 45 second-feet, February 5–7.

1914–1917: Maximum stage recorded, 4.75 feet, June 5, 1914 (discharge, about 1,570 second-feet); minimum discharge estimated 45 second-feet, February 5–7, 1917.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—Two dams are used in connection with grist mills above the station, but the plants have little pondage so that the flow at the gage, except for brief periods, is nearly natural.

ACCURACY.—Stage-discharge relation probably permanent, except as affected by ice. Rating curve used October 1 to April 2 well defined between 116 and 1,370 second-feet; curve used April 3 to September 30 fairly well defined from 105 to 1,370 second-feet. Gage read to quarter tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table; except during periods when stage-discharge relation is affected by ice, for which it was ascertained by applying to rating table mean daily gage height corrected for effect of ice by results of discharge measurements, observer's notes, and weather records. Open-water records fair, except for extremely low stages, when diurnal fluctuation may cause some error; winter records roughly approximate.

Discharge measurements of Plover River near Stevens Point, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 1[a]	E. L. Williams	1.52	75	Mar. 6[a]	E. L. Williams	1.89	80
Feb. 2[a]	....do	2.14	86	July 9	R. B. Kilgore	1.25	128

[a] Complete ice cover.

Daily discharge, in second-feet, of Plover River near Stevens Point, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	173	144	178	75	60	90	360	438	144	144	124	144
2	153	184	194	70	70	90	405	357	118	144	155	144
3	153	184	178	70	70	90	357	357	189	124	144	134
4	134	184	163	95	55	95	383	284	189	144	124	144
5	144	173	148	120	45	90	383	332	189	124	124	134
6	144	216	134	110	45	80	383	260	260	134	114	144
7	116	173	134	95	45	80	383	248	284	124	124	134
8	134	184	134	90	50	75	357	212	284	134	124	124
9	134	205	117	80	50	80	332	212	308	144	155	144
10	144	216	100	80	60	85	357	212	284	134	118	124
11	125	216	95	75	70	90	308	189	166	124	166	114
12	134	194	95	70	75	90	332	189	260	144	144	124
13	173	194	90	70	70	100	308	212	212	134	166	114
14	144	185	85	65	70	115	284	118	212	124	357	105
15	134	175	85	60	75	130	224	189	189	124	332	105
16	144	165	85	60	80	145	236	166	118	124	284	124
17	134	145	100	60	80	140	236	189	166	134	200	124
18	134	125	110	65	80	130	260	189	166	124	144	134
19	125	163	105	60	75	110	260	189	134	114	124	105
20	163	163	100	60	70	95	357	189	144	105	124	105
21	153	168	110	65	70	140	332	189	88	105	134	124
22	153	173	125	70	75	185	357	118	144	124	144	124
23	163	163	120	60	80	230	332	189	166	124	88	105
24	153	153	115	55	85	215	308	166	96	124	166	144
25	173	163	100	55	80	240	189	144	166	124	155	134
26	163	173	85	55	75	260	189	166	212	114	124	144
27	153	178	85	50	80	250	189	166	200	124	75	134
28	173	184	85	55	90	240	284	144	144	96	80	105
29	194	174	80	60	....	245	296	144	144	88	124	124
30	153	163	70	60	....	250	357	144	144	88	134	124
31	153	....	70	50	....	305	....	166	....	105	144	....

NOTE.—Stage-discharge relation affected by ice Nov. 14-17, Dec. 11 to Apr. 2.

Monthly discharge of Plover River near Stevens Point, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 136 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	194	116	149	1.10	1.27
November	216	125	176	1.29	1.43
December	194	70	112	.823	.95
January	120	50	69.8	.513	.59
February	90	45	68.9	.507	.53
March	305	75	147	1.08	1.25
April	405	189	311	2.29	2.56
May	438	118	209	1.54	1.78
June	308	88	184	1.35	1.51
July	144	88	123	.904	1.04
August	357	75	152	1.12	1.29
September	144	105	127	.933	1.04
The year	438	45	153	1.12	15.24

BARABOO RIVER NEAR BARABOO, WIS.

LOCATION.—In sec. 33, T. 12 N., R. 7 E., at highway bridge 4 miles downstream from Baraboo, Sauk County, about 3 miles below creek rising near Devils Lake, coming in from right, and 15 miles above mouth of river.

DRAINAGE AREA.—572 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—December 18, 1913, to September 30, 1917.

GAGE.—Chain gage, attached to upstream side of bridge; read by Miss Agnes Schneider.

DISCHARGE MEASUREMENTS.—Made from downstream side of highway bridge to which gage is attached.

CHANNEL AND CONTROL.—Bed composed of sand and mud; control not well defined. Water confined to one channel except at flood stages, when right bank is overflowed for a distance of 1,000 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, about 17.5 feet March 26 (discharge, 4,200 second-feet); minimum discharge, 100 second-feet January 31.

1914–1917: Maximum stage recorded about 17.5 feet March 26, 1917 (discharge, 4,200 second-feet); minimum stage, 0.71 foot, at 7.30 a. m., July 26, 1916 (discharge, 76 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—In the vicinity of Baraboo, 4 miles above the station, there are four dams, and one at Reedsburg, 18 miles above the station. Smaller plants are also operated on the tributaries. The operation of these various plants causes diurnal fluctuation at the gage of about 0.3 foot at low-water stages. Estimates of mean monthly discharge probably represent nearly the natural flow.

ACCURACY.—Stage-discharge relation changed during high water of March, 1917. Rating curve used October 1, 1915, to March 21, 1917, fairly well defined between 167 and 2,600 second-feet; extended and roughly approximate above and below these limits. Curve used March 22 to September 30, 1917, fairly well defined between 150 and 3,270 second-feet. Gage read to quarter tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except for periods when stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good; winter records roughly approximate.

Discharge measurements of Baraboo River, near Baraboo, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 26[a]	E. L. Williams	2.20	121	Mar. 28[b]	W. G. Hoyt	14.77	3,110
Jan. 26[a]	.....do	2.94	154	May 3	E. L. Williams	7.38	974
Feb. 28[a]	.....do	2.81	154				

[a] Complete ice cover.

[b] 1,720 feet of overflow section; velocity in overflow section estimated from a boat. Area of cross section determined with level May 3.

Daily discharge, in second-feet, of Baraboo River near Baraboo, Wis., for the years ending Sept. 30, 1915 and 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1914-15.												
1	178	188	178				544	190	274	159	449	198
2	186	179	174				531	187	246	162	449	179
3	162	196	200				544	226	232	155	662	175
4	163	192	196				602	216	220	149	602	165
5	136	190	184	115	225	360	677	232	204	146	617	153
6	164	182	167				849	232	194	141	544	155
7	179	186	189				970	253	188	142	477	169
8	193	171	177				1,070	267	206	203	602	170
9	274	173	182				1,130	295	213	195	365	221
10	632	161	174				1,170	309	203	192	288	226
11	407	179	184			323	1,030	267	208	200	253	351
12	288	175	177			421	898	226	195	181	239	769
13	365	175	160			518	817	200	226	192	239	1,200
14	477	163				722	692	198	213	200	288	1,190
15	463	173		250	565	785	587	195	200	186	274	1,430
16	477	226				801	463	198	232	165	544	1,560
17	463	232	140			849	393	203	195	156	865	1,660
18	421					865	365	220	198	165	932	1,500
19	288					881	344	212	200	159	801	1,230
20	260					849	309	393	195	177	531	1,130
21	246	140				915	288	753	195	187	309	1,090
22	232					915	274	849	213	167	220	915
23	226					990	200	849	200	184	190	769
24	213					1,110	239	785	203	167	220	512
25	173				1,340	1,380	220	662	208	152	226	407
26	198	136	110	190		1,600	220	477	195	144	209	463
27	205	153				1,500	226	421	176	196	195	557
28	226	188				1,460	203	393	155	531	167	557
29	190	172				1,090	210	379	170	707	163	512
30	190	172				865	198	337	170	769	153	435
31	190	......				722	......	302	......	722	175	......
1916-17.												
1	378	572	364	130	215	230	1,050	890	440	1,010	231	150
2	273	497	364	200	185	225	799	1,050	671	1,130	186	144
3	259	378	308	215	215	205	703	970	1,390	970	180	142
4	252	329	294	205	130	160	628	832	1,200	890	168	174
5	246	226	336	215	200	240	575	623	1,110	671	186	168
6	232	266	294	175	190	225	545	470	1,290	455	174	151
7	196	287	287	150	240	310	470	383	1,660	355	290	168
8	188	364	301	155	230	330	411	369	1,600	327	440	174
9	184	497	280	215	175	340	383	355	1,520	313	313	180
10	174	482	246	120	155	390	369	313	1,520	299	341	186
11	213	407	226	200	125	425	341	271	1,460	299	285	186
12	213	392	232	190	190	515	299	250	1,110	257	218	192
13	226	364	220	190	190	703	285	218	687	244	218	192
14	213	364	245	140	200	783	257	218	703	231	231	212
15	213	308	230	155	205	703	250	271	575	205	238	198
16	273	315	240	170	180	671	250	250	425	218	257	186
17	239	294	185	200	205	591	285	192	313	231	244	186
18	232	294	190	200	220	591	299	186	285	231	205	174
19	213	308	125	190	205	500	455	285	278	218	180	198
20	252	329	120	155	195	623	1,010	313	257	205	180	192
21	308	378	185	130	205	1,110	1,320	383	244	180	174	212
22	294	364	180	170	225	1,630	1,340	671	231	397	192	212
23	392	422	150	195	225	2,570	1,340	767	1,240	1,010	152	174
24	422	617	105	190	215	2,850	950	799	1,990	1,030	186	180
25	572	602	95	175	185	3,670	623	639	2,080	930	168	180
26	707	497	145	175	225	4,200	530	455	2,150	850	154	206
27	677	467	145	165	220	3,390	500	639	1,840	671	162	192
28	617	452	205	140	185	3,200	500	783	1,390	383	163	192
29	527	392	205	205	......	2,640	485	832	1,150	244	180	156
30	497	364	175	190	......	2,150	545	703	890	205	174	149
31	557	......	120	100	......	1,440	......	515	......	231	162	......

NOTE.—Stage-discharge relation affected by ice Dec. 13, 1916, to Mar. 10, 1917. Water above gage on Mar. 25 and 26, 1917; discharge based on stage as noted on bridge structure. Discharge record for the year ending Sept. 30, 1915, supersedes that published in Water-Supply Paper 405, p. 143, owing to a revision of rating curve above 500 second-feet.

Monthly discharge of Baraboo River near Baraboo, Wis., for the years ending Sept. 30, 1915 and 1917.

[Drainage area, 572 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1914-15.					
October	632	136	273	0.477	0.55
November	202		109	.205	.33
December	200		146	.255	.29
January			185	.323	.37
February			665	1.16	1.21
March	1,600		747	1.31	1.51
April	1,170	108	544	.951	1.06
May	849	187	353	.617	.71
June	274	155	206	.360	.40
July	769	141	237	.414	.48
August	932	153	395	.691	.80
September	1,660	153	670	1.17	1.30
The year	1,660		380	.664	9.01
1916-17.					
October	707	174	330	.577	.67
November	617	226	394	.689	.77
December	364	95	219	.383	.44
January	215	100	174	.304	.35
February	200	130	198	.346	.36
March	4,200	160	1,210	2.12	2.44
April	1,340	250	593	1.04	1.16
May	1,050	186	513	.897	1.03
June	2,150	231	1,000	1.85	2.06
July	1,130	180	480	.839	.97
August	440	152	214	.374	.43
September	212	142	180	.315	.35
The year	4,200	95	465	.813	11.03

NOTE.—Monthly discharge record for the year ending Sept. 30, 1915, supersedes that published in Water-Supply Paper 405, p. 144, owing to revision of rating curve above 500 second-feet.

KICKAPOO RIVER AT GAYS MILLS, WIS.

LOCATION.—In sec. 28, T. 10 N., R 4 W., at highway bridge immediately below Norwood Mill, in Gays Mills, Crawford County, 25 miles above mouth of river and 2 miles below mouth of Tainter Creek, which enters from right.

DRAINAGE AREA.—629 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles.

RECORDS AVAILABLE.—December 25, 1913, to September 30, 1917.

GAGE.—Chain gage fastened to downstream side of bridge; read by N. T. Norwood.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge at medium and high-water stages; low-water measurements made by wading a short distance downstream from gage.

CHANNEL AND CONTROL.—Bed composed of rock covered by a deposit of sand; banks at gage section fairly high and not subject to overflow at ordinary high-water stages. Control at the head of small rapids about 300 feet below gage; probably not permanent; the plotting of the discharge measurements indicates that at a stage of about 2 feet on the gage the control is changed to some point below, causing a reversal in the curve.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 15.05 feet March 24 (discharge about 6,300 second-feet); minimum discharge, about 160 second-feet, February 10.

1914–1917: Maximum discharge recorded March 24, 1917; minimum discharge, about 100 second-feet, last part of January, 1915.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—Mills at Gays Mills immediately above station, at Soldiers Grove, 7 miles upstream, and at several points above Soldiers Grove use comparatively little storage, so that the recorded flow past the station represents nearly the natural conditions. During low stages a small diurnal fluctuation is observed at the gage.

ACCURACY.—Stage-discharge relation not permanent. Rating curve used October 1 to March 20, well defined between 211 and 485 second-feet; fairly well defined between 485 and 1,340 second-feet; extended and subject to error above 1,340 second-feet. Curve used March 21 to September 30, poorly defined between 300 and 2,200 second-feet; extended and subject to error above and below these limits. Gage read to quarter tenths twice a day. Daily discharge ascertained by applying mean daily gage height to rating table except for period when stage-discharge relation was affected by ice, for which period it was ascertained by applying to rating table mean daily gage height corrected for effect of ice by discharge measurements, observer's notes, and weather records. Open-water records fair; winter records subject to error.

Discharge measurements of Kickapoo River at Gays Mills, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 5[a]	E. L. Williams	2.12	274	Mar. 22	W. G. Hoyt	7.65	1,980
Feb. 16[a]	.....do	2.48	260	Aug. 1	R. B. Kilgore	3.74	894

[a] Ice at control.

Daily discharge, in second-feet, of Kickapoo River at Gays Mills, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	355	405	368	225	190	265	680	820	455	1,170	690	345
2	355	380	355	225	245	265	640	920	580	995	945	360
3	325	355	310	265	215	310	580	660	895	640	680	360
4	310	355	310	295	185	325	565	550	680	535	515	345
5	295	340	300	275	235	325	565	515	550	515	495	375
6	280	325	300	265	175	340	550	475	770	550	475	375
7	280	325	300	235	255	325	515	475	1,360	565	495	515
8	295	368	300	265	170	485	475	445	1,600	515	610	515
9	280	350	295	320	250	525	455	435	1,420	535	580	455
10	280	350	235	260	160	520	455	420	720	465	475	390
11	280	350	235	260	240	820	445	390	595	455	465	390
12	280	350	235	260	220	850	445	375	580	455	475	375
13	295	350	265	260	190	820	405	375	595	455	610	390
14	310	251	265	260	210	640	390	375	515	435	595	475
15	310	280	265	260	235	525	390	345	475	435	495	435
16	295	295	280	260	255	520	375	360	465	435	475	375
17	280	325	295	260	265	470	360	345	445	405	420	350
18	265	355	295	260	265	430	390	330	405	375	435	345
19	280	355	295	260	265	405	640	640	420	405	390	360
20	295	355	280	295	265	545	1,200	515	405	360	405	435
21	430	368	295	215	270	870	1,640	420	390	345	390	435
22	470	380	280	215	275	2,130	970	515	465	3,500	375	405
23	368	355	265	300	280	2,950	580	550	945	4,740	495	375
24	340	392	250	240	280	3,500	535	435	1,560	3,200	550	345
25	440	265	265	280	280	3,300	550	375	1,990	2,020	475	345
26	485	310	265	220	280	2,800	595	375	1,740	770	445	345
27	450	392	295	275	285	2,100	565	625	970	610	375	345
28	392	380	295	200	290	1,390	515	580	640	590	375	360
29	430	368	280	205	....	970	595	445	820	535	375	330
30	522	368	250	195	....	870	770	402	700	515	360	315
31	478	....	235	280	....	770	....	455	....	475	360	....

NOTE.—Stage-discharge relation affected by ice Dec. 10 to Mar. 20. Gage not read Nov. 9–13 and Dec. 5–8; discharge interpolated.

Monthly discharge of Kickapoo River at Gays Mills, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 629 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	522	265	347	0.552	0.64
November	405	251	347	.552	.62
December	368	235	283	.450	.52
January	320	195	255	.405	.47
February	290	160	240	.382	.40
March	3,500	265	1,010	1.61	1.86
April	1,640	360	594	.944	1.05
May	920	330	482	.766	.88
June	1,990	390	805	1.28	1.43
July	4,740	345	903	1.44	1.66
August	945	360	493	.784	.90
September	515	315	386	.614	.68
The year	4,740	160	514	.817	11.11

TURKEY RIVER AT GARBER, IOWA.

LOCATION.—In sec. 36, T. 92 N., R. 4 W., at single-span highway bridge at Garber, Clayton County, about 800 feet above mouth of Wayne Creek, which enters from right.

DRAINAGE AREA.—1,530 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—August 29, 1913, to November 29, 1916, except October 1, 1914, to March 30, 1915. Station discontinued November 30, 1916.

GAGE.—Chain gage attached to handrail on downstream side of bridge; read once daily by E. J. Prolow.

DISCHARGE MEASUREMENTS.—Make from bridge, or by wading.

CHANNEL AND CONTROL.—Bed is composed of sand and mud; channel shifting. Right bank high and not subject to overflow; left bank will be overflowed only at extreme high stage or at gage height about 21 feet.

EXTREMES OF STAGE.—The highest stage within the last 20 years probably occurred May 18, 1902, when a stage representing about 23.7 feet referred to the gage datum was reached, as indicated by the highwater marks on A. F. Grafe's residence in Garber.

ICE.—Stage-discharge relation affected by ice, observations discontinued.

REGULATION.—An electric-light plant and gristmill at Elkader probably cause a slight daily fluctuation.

Data inadequate for determining daily or monthly discharge.

The following discharge measurement was made by C. Herlofson:

November 23, 1916: Gage height, 3.86 feet; discharge, 302 second-feet.

Daily gage height, in feet, of Turkey River at Garber, Iowa, for the period Oct. 1 to Nov. 29, 1916.

Day.	Oct.	Nov.	Day.	Oct.	Nov.	Day.	Oct.	Nov.
1	4.0	3.85	11	3.7	3.95	21	3.9	4.0
2	4.0	3.8	12	3.7	3.9	22	3.85	
3	3.85	3.75	13	3.7	3.9	23	3.9	
4	3.85	3.75	14	3.7	4.1	24	4.0	3.9
5	3.8	3.75	15	3.7	4.1	25	4.0	3.85
6	3.8	4.0	16	3.7	4.1	26	4.0	3.85
7	3.75	4.0	17	3.7	4.1	27	4.1	3.85
8	3.65	3.95	18	3.7	4.1	28	4.2	3.85
9	3.6	3.95	19	3.7	4.1	29	4.1	3.85
10	3.6	3.95	20	3.95	4.0	30	4.0	
						31	4.0	

MAQUOKETA RIVER BELOW NORTH FORK OF MAQUOKETA RIVER, NEAR MAQUOKETA, IOWA.

Location.—In the southwest corner of the NE. ¼ sec. 17, T. 84 N., R. 3 E., at Bridgeport Bridge, about 3 miles northeast of Maquoketa, Jackson County, 1,200 feet above mouth of Mill Creek and 2 miles below mouth of North Fork of Maquoketa River.

Drainage area.—1,600 square miles (measured on map issued by United States Geological Survey, scale, 1 to 500,000). Drainage area at mouth, 1,960 square miles.

Records available. September 1, 1913, to September 30, 1917, except October, 1914, to March 20, 1915, when station was temporarily discontinued.

Gage.—Chain gage attached to downstream handrail of bridge 100 feet from right abutment; read by John Strodthoff.

Discharge measurements.—Make from bridge to which gage is attached.

Channel and control.—Bed of stream composed of sand; shifting. Two channels at all stages except above 12-foot stage above which there is overflow under pile-trestle approach on the left side.

Extremes of discharge.—Maximum stage recorded during year, 16.8 feet at 1.30 p. m., June 13 (discharge, 11,800 second-feet); minimum stage recorded, 1.65 feet, November 15 (discharge, 296 second-feet).

Prior to 1917: Maximum stage about 23.5 feet, probably in 1905 (discharge, about 24,300 second-feet).

Diversions.—None.

Regulation.—None.

Accuracy.—Stage-discharge relation changed probably during high water March 10-14. Rating curves used before and after the change well defined between 300 and 20,000 second-feet. Gage read once daily to hundredths. Daily discharge, except as noted below ascertained by applying daily gage height to rating table. Stage-discharge relation affected by ice December 14 to March 9; determination of discharge based on observer's notes and weather records. Open-water records good; winter records roughly approximate.

Discharge measurements of Maquoketa River below North Fork of Maquoketa River, near Maquoketa, Iowa, during the year ending Sept. 30, 1917.

[Made by C. Herlofson.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec-ft.*		*Feet.*	*Sec.-ft.*
November 24	2.10	438	September 17	1.97	366
June 24	3.35	906	17	1.96	360

Daily discharge in second-feet, of Maquoketa River below North Fork of Maquoketa River, near Maquoketa, Iowa, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June.	July.	Aug.	Sept.
1	422	439	422				577	615	504	655	419	309
2	405	422	422				558	697	577	615	402	324
3	388	422	439				540	741	1,650	577	386	324
4	388	422	439				504	655	1,170	540	370	615
5	372	405	405			400	504	615	1,280	540	370	469
6	372	405	422				504	578	1,600	540	355	540
7	372	388	422				469	540	3,030	504	370	615
8	356	422	439				469	504	2,770	504	1,380	832
9	325	456	405				469	469	2,320	577	615	504
10	310	456	325			7,080	435	469	2,130	540	504	453
11	356	439	356			7,530	419	469	1,710	540	435	402
12	372	422	388			5,390	435	435	1,380	540	402	386
13	372	439	340			2,770	435	419	11,200	504	402	370
14	372	356				7,720	402	419	4,750	577	386	386
15	356	296			250	2,640	386	419	2,640	469	386	370
16	372	340		250		2,700	386	386	2,010	469	386	370
17	340	372				1,950	402	386	1,540	469	386	370
18	372	405				2,260	402	386	1,330	469	355	339
19	372	439				1,380	402	386	1,120	435	324	339
20	422	456				1,430	469	386	1,020	419	338	339
21	456	439				3,370	435	370	927	402	355	339
22	439	439	300			4,050	435	419	832	469	339	339
23	422	439				3,160	435	469	832	504	339	309
24	388	474				2,070	419	469	927	1,170	324	339
25	590	372				1,620	419	435	927	1,540	324	309
26	550	372				1,170	402	419	1,070	832	324	309
27	530	439				975	402	419	879	655	339	339
28	474	492				832	386	419	741	577	309	339
29	474	456				741	419	402	786	523	309	339
30	474	439				655	435	435	655	469	309	324
31	456					615		540		469	309	

Monthly discharge of Maquoketa River below North Fork of Maquoketa River, near Maquoketa, Iowa, for the year ending Sept. 30, 1917.

[Drainage area, 1,600 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	590	310	409	0.255	0.29
November	492	296	419	.262	.29
December	439		343	.214	.25
January			250	.156	.18
February			250	.156	.16
March	7,720		2,120	1.32	1.52
April	577	386	445	.278	.31
May	741	370	476	.297	.34
June	11,200	504	1,810	1.13	1.26
July	1,540	402	584	.365	.42
August	1,380	309	405	.253	.29
September	832	309	398	.249	.28
The year	11,200		659	.411	5.59

ROCK RIVER AT AFTON, WIS.

LOCATION.—On line between secs. 22 and 27, T. 2 N., R. 12 E., at highway bridge in Afton, Rock County, about 9 miles above Illinois State line. Bass Creek enters from right about three-quarters of a mile below station.

DRAINAGE AREA.—3,190 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—February 5, 1914, to September 30, 1917.

GAGE.—Chain gage fastened to the downstream side of bridge; read by Albert Engelke.

DISCHARGE MEASUREMENTS.—Made from the downstream side of bridge, or by wading.

CHANNEL AND CONTROL.—Banks medium high, and will not be overflowed to any extent at flood stages. Bed composed of gravel and clean silt; practically permanent. Control not well defined.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.90 feet at 4 p. m. April 1 (discharge, 8,910 second-feet); minimum discharge, 555 second-feet, February 11.

1914–1917: Maximum stage recorded, 9.88 feet at 4 p. m., September 13, 1915 (discharge, 10,300 second-feet); minimum stage recorded, 0.5 foot at 7 a. m. August 16, 1914 (discharge, about 459 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—Operation of power plants at Janesville and above causes fluctuations at the gage during low stages.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 638 and 10,500 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except for periods of ice effect, for which it was ascertained by applying to rating table mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good; winter records fair.

Discharge measurements of Rock River at Afton, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 20[a]	E. L. Williams	3.63	1,470	Feb. 26[b]	E. L. Williams	3.04	855
Jan. 24[b]	.....do	2.96	914	May 22	Hoyt and Williams	3.76	2,410

[a] Control partly covered with ice. [b] Practically complete ice cover.

Daily discharge, in second-feet, of Rock River at Afton, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,170	2,310	2,310	880	770	755	8,470	3,800	2,400	8,040	1,740	756
2	1,140	2,400	2,400	880	640	785	8,470	4,040	2,670	8,330	1,660	803
3	1,460	2,490	2,400	855	660	820	7,470	3,920	2,670	8,470	1,620	894
4	1,140	2,400	1,580	885	620	715	7,330	4,160	3,240	8,470	1,500	955
5	1,140	2,310	2,220	880	640	890	7,190	4,160	3,140	8,470	1,290	1,010
6	1,320	2,400	2,140	810	790	940	7,050	4,400	3,680	8,470	1,360	1,000
7	1,200	2,400	2,220	720	745	1,180	6,770	4,040	3,560	8,330	1,460	1,000
8	1,060	2,310	2,310	790	735	1,300	6,630	3,800	4,160	8,040	1,360	1,320
9	1,430	2,580	2,140	715	735	1,230	6,490	3,450	4,520	7,900	1,230	980
10	1,260	2,490	1,980	765	695	1,360	5,810	3,340	4,400	7,620	1,290	1,170
11	1,140	2,400	2,060	780	555	2,670	5,420	3,240	4,520	7,190	1,230	852
12	1,060	2,400	2,060	740	615	2,490	5,420	3,040	4,520	7,050	1,360	990
13	1,170	2,400	2,060	810	665	2,940	5,290	3,240	5,810	6,490	1,260	1,050
14	1,040	2,220	2,060	700	710	2,400	4,900	2,670	5,290	6,070	1,260	1,040
15	1,000	2,220	1,900	730	705	2,760	4,520	2,400	5,030	5,680	1,290	1,070
16	1,400	2,220	1,900	815	705	3,240	4,400	2,220	4,640	5,550	1,290	1,000
17	1,170	2,310	1,620	805	690	2,760	4,160	2,060	4,400	5,160	1,140	941
18	1,140	2,140	1,580	690	660	2,850	3,920	1,900	4,400	4,640	875	970
19	1,140	2,140	1,500	725	705	3,040	4,040	2,140	4,160	4,160	746	980
20	1,360	2,220	1,430	815	695	3,920	4,160	2,140	4,040	3,920	894	1,090
21	1,430	2,140	1,320	720	630	4,160	3,920	2,060	3,920	3,560	894	1,170
22	1,290	2,140	1,230	855	750	4,520	3,920	2,400	3,920	3,240	990	1,200
23	1,500	2,220	1,100	720	725	4,900	4,280	1,980	3,920	3,140	875	970
24	1,580	2,220	1,040	860	640	5,290	4,280	1,900	4,160	2,850	1,010	941
25	1,820	1,900	980	835	650	5,810	4,160	2,140	4,900	3,040	848	1,070
26	1,980	1,980	1,060	785	715	6,630	4,400	2,400	5,810	2,490	820	1,100
27	1,980	2,140	1,030	795	770	7,190	3,800	2,670	6,350	2,490	903	1,360
28	1,700	2,310	1,080	775	705	7,900	3,800	2,580	7,050	2,220	852	1,170
29	2,060	2,490	980	775	....	8,040	3,800	2,310	7,470	1,980	788	1,100
30	2,310	2,310	960	885	....	7,900	3,920	2,140	8,330	1,900	894	1,080
31	2,310	....	925	895	....	7,900	....	2,490	....	2,060	970	....

NOTE.—Stage-discharge relation affected by ice Nov. 11-14 and Dec. 14 to Mar. 8.

Monthly discharge of Rock River at Afton, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 3,190 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	2,310	1,000	1,420	0.445	0.51
November	2,580	1,900	2,290	.718	.80
December	2,400	925	1,600	.520	.60
January	895	700	796	.250	.29
February	790	555	690	.216	.22
March	8,040	715	3,530	1.11	1.28
April	8,470	3,800	5,270	1.65	1.84
May	4,400	1,900	2,880	.903	1.04
June	8,330	2,400	4,570	1.43	1.60
July	8,470	1,900	5,390	1.69	1.95
August	1,740	746	1,150	.361	.42
September	1,360	756	1,030	.323	.36
The year	8,470	555	2,560	.803	10.91

ROCK RIVER AT ROCKFORD, ILL.

LOCATION.—In sec. 34, T. 44 N., R. 1 E., at highway bridge at Nelson Avenue, Rockford, Winnebago County, about 1 mile below mouth of Kent Creek.

DRAINAGE AREA.—6,520 square miles.

RECORDS AVAILABLE.—July 30, 1914, to September 30, 1917.

GAGE.—Chain gage attached to upstream side of bridge; read by Winston Burrows.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge.

CHANNEL AND CONTROL.—Coarse gravel and rock; may shift in high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.8 feet June 21 to 23 (discharge, 13,700 second-feet); minimum stage, 1.70 feet at 5.30 p. m. September 30 (discharge, 1,180 second-feet).

1914–1917: Maximum stage recorded, 15.5 feet February 15, 1915 (discharge not determined because of backwater from ice); maximum open-water stage recorded, 13.0 feet March 30 and 31, 1916 (discharge, 32,000 second-feet); minimum stage, 0.82 foot, August 9, 1914 (discharge, 483 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—Operation of power plant at dam 2 miles upstream in city of Rockford causes slight fluctuation at gage.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve fairly well defined between 1,450 and 32,000 second-feet. Gage read to hundredths twice daily. Fluctuation at gage only slight. Daily discharge ascertained by applying mean daily gage height to rating tables, except for period when stage-discharge relation was affected by ice, for which it was determined from gage heights, observer's notes, weather records, and records of flow of Rock River at Afton, Wis. Open-water records good for medium and high stages; probably somewhat too large for low stages, as gage readings were taken during day when flow, owing to regulation at dam, is somewhat greater than during night; winter records poor.

The following discharge measurement was made by H. C. Beckman:

August 29, 1917; Gage height: 2.47 feet; discharge, 1,950 second-feet.

Daily discharge, in second-feet, of Rock River at Rockford, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	3,100	3,810	3,810				11,800	6,770	4,200	3,440	3,440	1,870
2	3,270	3,620	4,000				11,200	7,000	4,400	3,620	3,100	1,760
3	3,270	3,620	4,000				10,200	7,230	4,200	4,200	2,790	1,760
4	3,270	3,620	3,810			2,110	9,680	7,000	4,400	4,400	2,500	1,870
5	3,440	3,810	4,000	1,620	1,650		9,180	6,770	4,820	5,240	2,500	1,760
6	3,620	3,810	4,000				8,930	6,320	5,030	5,880	2,500	1,650
7	4,000	3,620	3,810				8,680	6,100	6,770	6,540	2,230	1,650
8	2,940	3,810	3,810			3,810	8,430	5,450	7,950	7,000	2,100	1,650
9	3,100	4,400	3,620			4,820	7,950	5,030	8,680	7,950	1,980	1,450
10	3,100	4,610	3,620			5,660	7,950	4,820	9,180	8,680	2,100	1,550
11	3,270	4,610	3,620			6,540	7,470	4,820	9,180	8,930	2,100	1,650
12	3,270	4,400	3,620			7,950	7,000	4,610	9,430	8,680	2,230	1,650
13	3,440	4,400	3,810			10,200	6,770	4,610	9,430	8,430	2,100	1,650
14	3,440	4,610	3,810			11,200	6,540	4,200	10,200	7,950	1,980	1,870
15	3,440	4,400	3,810	1,890	1,920	11,800	6,100	4,000	10,700	7,470	1,870	2,100
16	3,100	4,400				12,800	5,660	4,000	11,500	7,000	1,980	1,980
17	2,940	4,200				13,100	5,240	3,810	11,800	6,770	1,870	2,100
18	2,940	4,000				12,800	5,030	3,810	12,300	6,540	1,870	2,360
19	2,940	3,620				13,100	4,820	3,440	12,600	6,320	1,760	2,360
20	3,270	3,620				13,100	5,880	3,440	13,100	6,320	1,760	2,230
21	3,620	3,810				12,800	6,320	3,440	13,700	6,100	1,760	2,100
22	3,810	3,810				12,600	5,450	3,620	13,700	6,100	1,760	1,980
23	4,200	3,620	2,840			12,800	5,240	3,440	13,700	5,880	1,760	1,980
24	4,400	3,620				12,800	4,820	3,440	13,100	5,450	1,870	1,870
25	4,400	3,440			1,990	13,100	5,240	3,270	12,300	5,030	1,980	1,870
26	4,200	3,440		1,860		12,600	5,450	3,270	11,500	4,820	2,100	1,650
27	4,400	3,440				12,600	5,880	3,620	11,000	4,820	2,100	1,550
28	4,200	3,620				12,300	6,100	3,440	10,700	4,610	1,960	1,450
29	4,000	3,620			....	12,300	6,320	3,620	9,940	4,400	1,980	1,360
30	4,000	3,810			....	12,600	6,770	3,810	9,430	4,200	1,870	1,190
31	4,000	....			....	12,600	....	4,000	....	3,810	1,870	....

NOTE.—Stage-discharge relation affected by ice Dec. 16 to Mar. 7. Sudden decrease in flow from June 30 to July 1 caused by regulation at dam upstream. Braced figures show mean discharge for periods included.

Monthly discharge of Rock River, at Rockford, Ill., for the year ending Sept. 30. 1917

[Drainage area, 6,520 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	4,400	2,940	3,560	0.546	0.63
November	4,610	3,440	3,910	.600	.67
December	4,000	....	3,310	.508	.59
January	....	....	1,790	.275	.32
February	....	....	1,840	.282	.29
March	13,100	....	9,060	1.39	1.60
April	11,800	4,820	7,070	1.08	1.20
May	7,230	3,270	4,590	.704	.81
June	13,700	4,200	9,630	1.48	1.65
July	8,930	3,440	6,020	.923	1.06
August	3,440	1,760	2,120	.325	.37
September	2,360	1,180	1,800	.276	.31
The year	13,700	1,180	4,570	.701	9.50

ROCK RIVER AT LYNDON, ILL.

LOCATION.—In sec. 21, T. 20 N., R. 5 E., at highway bridge known as Lyndon Bridge, in eastern part of Lyndon, Whiteside County; about 10 miles above Rock Creek and 20 miles below dam at Sterling.

DRAINAGE AREA.—9,010 square miles.

RECORDS AVAILABLE.—November 24, 1914, to September 30, 1917.

GAGE.—Chain gage attached to bridge; read by John Shepard.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Gravel; may shift.

Extremes of discharge.—Maximum stage recorded during year, 15.2 feet March 14 (discharge not determined because of backwater from ice); maximum open-water stage recorded, 12.6 feet at 7 a. m. June 14 (discharge, 21,400 second-feet); minimum stage recorded, 4.6 feet at 5 p. m. September 2 (discharge, 1,170 second-feet).

1915–1917: Maximum stage recorded, 18.0 feet January 22 and 23, 1916 (discharge not determined because of backwater from ice); maximum open-water stage recorded, 17.0 feet March 28, 1916 (discharge, 39,500 second-feet). Minimum discharge recorded, 1,170 second-feet at 5 p. m. September 2, 1917.

Ice.—Stage-discharge relation seriously affected by ice.

Diversions.—Water is diverted at Sterling dam to feed Illinois and Mississippi canal; probably averages about 100 second-feet.

Regulation.—Operation of power plant in city of Sterling causes fluctuation at gage. Fluctuations slight except during low stages.

Accuracy.—Stage-discharge relation changed during March; affected by ice during winter. Rating curves well defined. Gage read to hundredths twice daily. Diurnal fluctuation at gage not large. Daily discharge ascertained by applying mean daily gage height to rating table, except for period when stage-discharge relation was affected by ice, for which it was ascertained from gage heights, observer's notes, weather records, and record of flow of Rock River at Rockford, Ill., and Afton, Wis. Records good for medium and high stages and fair for very low stages during open-water periods; poor for winter period.

Daily discharge measurements of Rock River at Lyndon, Ill., during the year ending Sept. 30, 1917.

[Made by H. C. Beckman.]

	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Sept. 1	5.31	2,060
Do	4.82	1,430

Daily discharge, in second-feet, of Rock River at Lyndon, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	3,900	4,530	5,110				10,600	8,080	5,500	10,100	3,540	2,210
2	4,340	3,800	4,340				10,400	9,330	5,720	10,600	3,360	1,710
3	3,460	3,980	3,980				10,200	9,580	5,290	11,500	3,180	2,210
4	2,980	4,530	4,910				10,000	9,330	6,170	10,400	2,840	2,360
5	3,140	4,340	4,160				9,830	8,080	6,630	10,600	2,520	2,520
6	3,140	4,720	5,310	2,780	2,910	3,930	9,830	7,340	7,580	10,600	2,840	1,920
7	2,980	3,980	4,720				9,830	7,580	9,330	10,400	3,010	2,210
8	2,680	4,720	4,530				9,330	5,720	8,830	10,100	2,840	2,520
9	2,980	4,530	4,340				9,330	6,400	9,580	10,100	3,010	1,920
10	2,980	4,910	4,160				9,080	6,170	9,580	9,830	2,680	2,680
11	2,980	5,520					8,580	5,940	9,830	9,830	2,840	2,520
12	2,980	5,110					8,080	5,720	9,830	9,330	2,210	2,680
13	2,680	5,310					7,830	5,290	16,000	8,830	3,010	2,680
14	2,980	5,110					7,340	5,290	20,200	8,830	3,010	2,680
15	2,680	4,720					7,580	5,080	18,500	8,080	2,680	2,680
16	2,980	4,340	4,300	2,530	2,410	17,500	6,860	4,280	14,500	7,340	2,680	2,520
17	2,680	4,340					6,400	4,280	14,200	7,830	2,680	2,520
18	2,980	4,340					6,630	4,090	13,900	6,860	2,680	2,680
19	2,830	3,980					6,400	3,900	11,800	6,630	2,060	2,520
20	3,140	4,340					6,170	2,840	9,580	7,830	2,680	2,520
21	3,140	4,340				18,100	6,630	3,900	8,330	8,080	2,520	2,520
22	4,160	4,340				17,300	7,340	3,900	7,340	6,400	1,710	2,680
23	4,530	4,530				16,500	7,830	4,090	7,100	6,400	2,060	2,210
24	4,720	4,530				15,700	7,580	4,680	7,100	5,290	2,360	2,680
25	4,340	4,340			2,520	15,000	7,580	4,880	6,860	5,500	2,210	2,680
26	5,730	3,980	3,390	2,750		14,200	6,630	4,680	7,100	5,290	1,920	2,520
27	5,950	4,530				13,400	7,580	4,680	9,080	4,880	2,360	2,520
28	5,730	4,530				12,600	7,100	5,500	9,330	4,680	1,920	2,680
29	5,110	4,530			......	11,800	6,630	5,500	10,400	3,180	2,060	2,520
30	5,730	4,340			......	11,400	6,630	5,290	10,100	4,480	2,210	2,360
31	5,310	......			......	10,900	......	5,500	......	3,360	1,920	......

Note.—Stage-discharge relation affected by ice Dec. 11 to Mar. 20. Discharge Mar. 21–23, 25, 27, 28, 30, and Apr. 1, 3, 4, and 6 interpolated. Braced figures show mean discharge for period included.

Monthly discharge of Rock River at Lyndon, Ill., for the year ending Sept. 30, 1917.

[Drainage area, 9,010 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	5,950	2,680	3,740	0.415	0.48
November	5,520	3,800	4,500	.499	.56
December			4,060	.451	.52
January			2,690	.299	.34
February			2,620	.291	.30
March			12,000	1.33	1.53
April	10,600	6,170	8,060	.895	1.00
May	9,580	2,840	5,710	.634	.73
June	20,200	5,290	9,840	1.09	1.22
July	11,500	3,180	7,840	.870	1.00
August	3,540	1,710	2,570	.285	.33
September	2,680	1,710	2,450	.272	.30
The year			5,520	.613	8.31

YAHARA RIVER NEAR EDGERTON, WIS.

Location.—At highway bridge in sec. 3, T. 4 N., R. 11 W., 1 mile above mouth of Badfish River (coming in from right) and about 5 miles southwest of Edgerton, Rock County.

Drainage area.—380 square miles (measured on map issued by Wisconsin and Geological History Survey, edition of 1911; scale, 1 inch=6 miles).

Records available.—September 27, 1916 to November 23, 1917, when station was discontinued.

Gage.—Friez water-stage recorder in a wooden well fastened to the right-hand downstream wing wall.

Discharge measurement.—Made from downstream side of highway bridge.

Channel and control.—Bed composed of gravel, control is head of rapids a short distance downstream. During the summer months grass grows in the channel and on the control affecting stage-discharge relation.

Extremes of discharge.—Maximum stage recorded, 3.13 feet 2 a. m., June 13, 1917 (discharge, 1,390 second-feet); minimum stage, 1.64 feet 5 p. m., October 8, 1916 (discharge, about 118 second-feet).

Ice.—Stage-discharge relation seriously affected by ice.

Accuracy.—Stage-discharge relation not permanent; affected by grass and ice. Rating curve well defined between 290 and 780 second-feet; extended and subject to error above and below these limits. Operation of water-stage recorder satisfactory throughout the year. Daily discharge ascertained by discharge integrator; shifting-control method used September 27 to October 8, 1916, and June 1 to October 31, 1917; discharge December 14 to March 21 ascertained from discharge measurements, gage heights, and weather records. Open-water records good; winter records subject to error.

Discharge measurements of Yahara River near Edgerton, Wis., for the period Sept. 28, 1916, to November 23, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1916.		*Feet.*	*Sec.-ft.*	1917.		*Feet.*	*Sec.-ft.*
Sept. 28[a]	E. L. Williams	2.38	260	Feb. 26[c]	E. L. Williams	3.11	155
Oct. 13	do	2.46	362	Mar. 26	W. G. Hoyt	2.84	695
Dec. 19[b]	do	2.75	194	May 22	Hoyt and Williams	2.57	421
				July 17[d]	W. G. Hoyt	2.22	214
1917.				Nov. 8	R. B. Kilgore	2.47	379
Jan. 23[c]	do	2.96	175				

[a] Grass growing in channel.
[b] Almost complete ice cover at control.
[c] Complete ice cover at control.
[d] Possible grass growth at control.

Daily discharge, in second-feet, of Yahara River near Edgerton, Wis., for the period Sept. 27, 1916, to Nov. 23, 1917.

Day.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1916–17.													
1	......	253	430	365	177	131	137	718	671	327	237	274	232
2	......	240	466	331	186	125	141	618	554	380	227	283	253
3	......	236	446	324	177	139	137	584	509	317	216	278	241
4	......	239	414	318	183	158	129	599	500	332	218	315	242
5	......	252	429	319	177	157	141	621	420	300	217	258	263
6	......	257	373	301	193	160	145	527	429	371	224	284	251
7	......	249	350	307	183	163	243	561	377	387	206	335	275
8	......	460	414	324	179	151	247	638	375	372	201	308	227
9	......	350	460	320	192	153	179	497	384	251	207	302	238
10	......	334	445	324	189	147	245	535	362	332	196	323	246
11	......	331	421	290	175	123	559	523	362	305	204	2[illegible]5	250
12	......	354	450	350	160	154	367	513	348	325	200	291	235
13	......	370	355	341	161	151	287	514	386	517	208	323	253
14	......	339	433	210	155	141	342	452	311	346	210	331	232
15	......	381	659	210	152	149	384	451	324	315	210	332	255
16	......	355	531	210	158	150	395	414	306	291	210	321	238
17	......	370	367	210	145	151	306	384	289	295	210	344	252
18	......	372	352	210	150	120	396	446	306	235	215	275	242
19	......	390	384	210	152	142	348	596	328	241	206	270	236
20	......	523	346	210	144	132	529	487	346	238	209	294	241
21	......	474	361	210	154	133	856	507	298	234	218	315	235
22	......	452	335	210	158	129	972	421	412	223	228	393	223
23	......	427	369	210	165	126	859	368	313	286	227	389	216
24	......	416	387	210	170	132	841	400	335	255	235	280	233
25	......	541	368	210	168	128	744	416	331	326	240	273	236
26	......	500	410	210	162	155	728	412	308	270	248	285	235
27	213	526	336	210	165	158	705	396	346	222	253	294	230
28	270	424	378	210	161	146	672	425	283	241	263	275	245
29	255	507	396	210	160	......	652	567	289	222	258	247	245
30	290	448	375	210	166	......	666	488	302	224	278	240	251
31	......	451	......	210	141	......	595	......	306	......	272	257	......

Day.	Oct.	Nov.	Day.	Oct.	Nov.	Day.	Oct.	Nov.
1917.			1917.			1917.		
1	233	315	11	240	372	21	262	320
2	242	304	12	232	356	22	262	329
3	246	331	13	229	343	23	310	321
4	225	330	14	257	341	24	278	....
5	234	332	15	244	349	25	284	....
6	246	328	16	256	352	26	345	....
7	235	325	17	256	357	27	345	....
8	237	327	18	250	339	28	337	....
9	233	335	19	265	322	29	324	....
10	235	353	20	266	325	30	337	....
						31	300	....

NOTE.—Stage-discharge relation affected by grass Sept. 27 to Oct. 8, 1916, and June 1 to Oct. 31, 1917; affected by ice, Dec. 14 to Mar. 31. Discharge partially estimated Sept. 29 and 30, 1916, Apr. 14, and May 26–27, 1917. No gage-height record July 14–17; discharge estimated.

Monthly discharge of Yahara River near Edgerton, Wis., for the period Oct. 1, 1916, to Nov. 23, 1917.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1916–17.					
October	541	236	381	1.00	1.15
November	659	335	408	1.07	1.19
December	365	....	258	.679	.78
January	193	141	166	.437	.50
February	163	120	143	.376	.39
March	972	129	450	1.18	1.36
April	718	368	503	1.32	1.47
May	671	283	368	.968	1.12
June	517	222	299	.787	.88
July	278	196	224	.589	.68
August	393	240	298	.784	.90
September	275	216	242	.637	.71
The year	972	120	313	.824	11.13
1917.					
October	345	225	266	.700	.81
November 1–23	372	304	335	.882	.75

PECATONICA RIVER AT DILL, WIS.

Location.—In sec. 6, T. 1 N., R. 6 E., at Illinois Central Railroad bridge at Dill (Ramona post office), Green County, about 1 mile below junction of east and west branches of Pecatonica River and 9 miles above Illinois State line.

Drainage area.—959 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

Records available.—February 9, 1914, to September 30, 1917.

Gage.—Chain gage fastened to downstream side of bridge; prior to August 2, 1916, vertical staff gage on left abutment. Gage read by W. C. Shadewaldt and S. A. Frank.

Discharge measurements.—At low and medium stages made from upstream side of highway bridge about 400 feet above the gage; during extremely high water considerable water overflows to left of highway bridge and measurements are made from railroad bridge to which the gage is attached.

Channel and control.—Bed composed of sand and silt; undoubtedly shifting. Banks are only of medium height and are overflowed at flood stages. Except during extreme flood stages all the water passes under the bridge to which the gage is fastened. There is little fall in the river below the gage and no well-defined control.

Extremes of discharge.—Maximum stage recorded during year, 12.6 feet at 7 a. m. March 15 (discharge, about 4,500 second-feet); minimum discharge, 260 second-feet January 20–22.

1914–1917: Maximum stage, 19.1 feet March 27, 1916, determined from flood marks by leveling (discharge, about 13,100 second-feet); minimum discharge, January 20–31, 1915 (estimated mean discharge 245 second-feet).

Ice.—Stage-discharge relation affected by ice.

Regulation.—Operation of dams at Argyle, on the East Branch of Pecatonica River, and at Darlington, on the West Branch of Pecatonica River, cause little if any diurnal fluctuation at the gage.

Accuracy.—Stage-discharge relation changed somewhat during the period between June and September; also affected by ice. Rating curve used October 1 to June 30 well defined between 350 and 1,520 second-feet and fairly well defined between 1,520 and 6,000 second-feet; extension of the curve above 6,000 second-feet is based on the flow of Pecatonica River at Freeport, Ill. Discharge, June 14 to September 30 determined by shifting-control method; discharge for rest of open-water period ascertained by applying mean daily gage height to rating table; for period of ice effect determined by applying to rating table mean daily gage height corrected by means of discharge measurements, observers' notes, and weather records. Open-water records goods except those for July to September, which are only fair; winter records subject to error.

Discharge measurements of Pecatonica River at Dill, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 21[a]	E. L. Williams	1.40	279	Feb. 27[a]	E. L. Williams	1.77	296
Jan. 25[a]	.....do	1.78	279	May 23	Hoyt and Williams	2.04	585

[a] Complete ice cover.

Daily discharge, in second-feet, of Pecatonica River at Dill, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	390	474	438	265	270	300	524	537	630	565	356	290
2	390	474	438	270	270	325	524	698	809	551	367	290
3	402	474	426	270	270	350	498	846	1,840	486	356	290
4	390	474	426	270	275	400	486	630	1,800	450	356	290
5	390	450	438	270	275	450	486	551	1,160	438	356	295
6	378	450	438	270	275	565	474	524	1,320	426	356	314
7	378	462	402	275	275	700	474	486	1,560	438	414	325
8	378	474	402	275	275	1,120	474	462	1,600	426	462	356
9	367	537	414	275	270	1,480	474	462	1,280	414	414	367
10	367	537	390	270	270	2,100	438	462	1,000	402	335	325
11	367	511	390	270	270	2,510	450	450	846	402	312	305
12	402	462	365	270	270	2,830	426	450	809	390	325	302
13	390	450	355	270	270	2,880	426	438	2,880	390	312	320
14	402	426	345	270	275	3,230	414	426	1,970	378	323	378
15	390	402	335	265	275	4,430	402	426	1,240	367	320	356
16	402	462	325	265	275	4,280	414	426	735	390	316	321
17	378	486	315	270	270	4,030	414	426	630	414	311	320
18	378	486	305	270	280	3,230	426	414	596	367	304	335
19	378	450	300	260	280	2,560	1,200	426	551	356	307	345
20	414	426	290	260	280	1,880	1,000	426	498	345	304	367
21	551	414	280	260	285	2,460	630	438	498	345	298	345
22	596	402	270	260	285	3,280	551	450	498	414	298	320
23	474	426	270	265	290	3,280	511	511	551	524	307	305
24	438	462	275	265	285	2,240	486	486	630	524	307	300
25	551	474	275	275	295	1,240	450	426	565	511	304	302
26	846	390	280	275	300	772	474	414	664	498	304	305
27	630	498	270	275	295	630	474	462	664	414	304	323
28	596	474	275	270	295	630	474	772	524	378	300	323
29	486	414	275	275	....	551	486	551	524	367	297	304
30	511	414	270	275	....	524	498	511	551	378	293	300
31	486	....	265	275	....	498	....	630	....	367	293	....

NOTE.—Stage-discharge relation affected by ice Dec. 12 to Mar. 19.

Monthly discharge of Pecatonica River at Dill, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 959 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	846	367	448	0.467	0.54
November	537	390	458	.478	.53
December	438	265	340	.355	.41
January	275	260	269	.280	.32
February	300	270	279	.291	.30
March	4,430	300	1,800	1.88	2.17
April	1,200	402	515	.537	.60
May	846	414	504	.526	.61
June	2,880	498	981	1.02	1.14
July	565	345	423	.441	.51
August	462	293	329	.343	.40
September	378	290	321	.335	.37
The year	4,430	260	558	.582	7.90

PECATONICA RIVER AT FREEPORT, ILL.

LOCATION.—In sec. 32, T. 27 N., R. 8 E., at highway bridge at Hancock Avenue, half a mile east of Illinois Central Railroad station at Freeport, Stephenson County, and 2 miles above mouth of Yellow Creek.

DRAINAGE AREA.—1,330 square miles.

RECORDS AVAILABLE.—September 10, 1914, to September 30, 1917.

GAGE.—Chain gage attached to upstream side of bridge; read by W. C. Krueger.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of sand and silt; likely to shift. Left bank is of only medium height and is overflowed during high water. At stages above about 16.0 feet part of the flow passes over the left bank and through East Freeport.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 16.0 feet at 8 a. m. March 16 (discharge, 6,140 second-feet); minimum stage, 3.5 feet August 31 and September 2 (discharge, 239 second-feet).

1914–1917: Maximum stage recorded, 19.4 feet March 28, 1916 (discharge, 17,000 second-feet); minimum discharge recorded August 31 and September 2, 1917.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—A dam and power plant three-fourths mile upstream regulate flow past gage. Only slight diurnal fluctuation is noticeable.

ACCURACY.—Stage-discharge relation changed, probably after high water in June; affected by ice during winter. Rating curve used to June 30 well defined; curve used August 21 to September 30 fairly well defined. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table; shifting-control method used July 1 to August 20. Records good for medium and high stages and fair for low stages during open-water periods, winter records poor.

The following discharge measurement was made by H. C. Beckman:

August 31, 1917: Gage height, 3.50 feet; discharge, 233 second-feet.

Daily discharge, in second-feet, of Pecatonica River at Freeport, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	918	894	632				757	824	1,220	735	395	335
2	894	801	612				757	1,020	1,320	755	395	364
3	801	714	593				735	990	1,500	715	380	335
4	735	652	574				714	847	1,680	656	395	335
5	652	632	632	390	430	1,140	652	801	1,650	600	380	350
6	555	632	693				693	779	1,740	675	335	471
7	537	714	757				672	757	2,020	656	380	410
8	519	735	894				632	714	2,060	600	542	380
9	502	894	942				593	672	1,920	582	490	395
10	485	894	894				593	632	1,770	582	458	380
11	485	824	693			3,450	574	612	1,590	564	426	335
12	555	757	502			3,830	555	574	1,440	546	410	320
13	612	672	381			3,830	555	574	2,380	528	395	306
14	555	593	381			4,460	555	555	3,830	528	395	292
15	574	519		395	405	5,810	735	555	3,450	546	395	350
16	593	502				6,140	537	537	1,260	528	395	365
17	555	502				5,660	593	485	1,220	511	395	365
18	519	537				5,250	1,040	469	1,140	511	390	350
19	555	612				5,000	1,340	502	990	494	380	350
20	612	757				4,560	1,340	502	894	494	395	335
21	847	801				3,830	1,190	519	847	458	335	365
22	593	824	400			3,060	990	574	801	474	278	365
23	537	847				3,310	1,040	735	824	490	292	335
24	632	779				3,120	1,440	870	894	542	335	305
25	918	714		445	475	2,340	1,440	801	990	580	335	292
26	1,120	779				1,440	966	693	942	524	335	306
27	1,120	735				1,090	801	672	918	474	350	395
28	1,060	693				942	672	632	870	442	335	410
29	966	652				847	632	714	870	442	292	395
30	1,020	612				735	652	824	942	442	292	365
31	990	....				714	....	1,040	....	426	335	....

NOTE.—Discharge Dec. 15 to Mar. 10 estimated because of ice from gage heights, observer's notes, weather records, and records of flow of Pecatonica River at Dill, Wis. Braced figures show mean discharge for periods indicated.

Monthly discharge of Pecatonica River at Freeport, Ill., for the year ending Sept. 30, 1917.

[Drainage area, 1,330 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,120	485	710	0.534	0.62
November	894	502	709	.533	.59
December	942	381	515	.387	.45
January	....	....	411	.309	.36
February	....	....	434	.326	.34
March	6,140	....	2,610	1.96	2.26
April	1,440	537	815	.613	.68
May	1,040	469	693	.521	.60
June	3,830	801	1,470	1.11	1.24
July	755	426	552	.415	.48
August	542	278	375	.282	.33
September	471	264	352	.265	.30
The year	6,140	264	806	.606	8.25

SUGAR RIVER NEAR BRODHEAD, WIS.

LOCATION.—In sec. 26, T. 2 N., R. 9 E., at highway bridge 2 miles southwest of Brodhead, Green County, about 12 miles above Illinois State line. Jordan Creek enters from right about 2 miles below station, and Little Jordan Creek, also from right, about 4 miles above.

DRAINAGE AREA.—529 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—February 7, 1914, to September 30, 1917.

GAGE.—Chain gage attached to downstream side of bridge; read by Arthur Christensen.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; control not well defined. Right bank of medium height; rarely overflowed. Left bank at the gage overflowed at stage of about 7 feet on the gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.48 feet at 4.30 p. m. June 13 (discharge, 2,710 second-feet); minimum discharge about 85 second-feet February 11.

1914–1917: Maximum stage recorded, 11.4 feet, September 13, 1915 (discharge about 13,000 second-feet); minimum stage recorded, 0.4 foot at 10 a. m., Sunday, August 30, 1914, when water was undoubtedly being held at the dam (discharge, determined from extension of the rating curve, about 74 second-feet).

ICE.—Stage-discharge relation affected by ice.

ACCURACY.—Stage-discharge relation not permanent; control changed somewhat by floods. Two rating curves as used for 1917, both only fairly well defined between 228 and 4,500 second-feet. Gage read daily to quarter-tenths. Daily discharge ascertained by applying mean daily gage height to rating table, except for periods of ice effect, for which it is ascertained by applying to rating table mean daily gage height corrected by means of discharge measurements, observer's notes, and weather records. Open-water records fair; winter records roughly approximate.

Discharge measurements of Sugar River near Brodhead, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 21[a]	E. L. Williams.........	2.15	162	Feb. 27[a]	E. L. Williams.........	2.58	138
Jan. 25[a]	.....do..................	2.33	144	May 23	Hoyt and Williams.....	2.01	374

[a] Practically complete ice cover.

Daily discharge, in second-feet, of Sugar River near Brodhead, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	237	296	296	160	185	160	370	620	475	660	262	262
2	246	284	274	180	165	160	388	660	660	580	222	173
3	246	296	237	175	170	165	354	620	830	475	222	222
4	237	274	274	165	150	140	405	423	830	370	222	235
5	228	237	274	160	170	170	370	370	875	338	210	248
6	351	296	255	165	165	165	354	322	1,060	388	248	248
7	237	264	255	150	170	255	338	338	920	440	248	306
8	202	274	296	165	165	510	276	338	875	405	262	338
9	228	322	322	170	135	545	322	322	785	322	248	197
10	228	383	255	160	140	585	276	322	545	306	306	322
11	228	383	255	165	85	1,580	276	276	338	306	322	306
12	228	284	245	165	115	1,830	291	276	440	338	248	235
13	228	308	235	150	120	1,720	276	222	2,710	338	276	276
14	237	322	230	130	125	1,240	276	262	2,350	306	262	291
15	168	296	200	155	130	1,120	222	276	1,390	306	276	306
16	274	255	195	145	135	1,100	248	276	740	475	291	222
17	237	264	180	150	150	1,010	262	262	580	475	262	262
18	219	264	175	160	150	1,180	291	262	475	405	248	248
19	237	228	170	165	170	1,090	423	248	458	306	173	262
20	246	296	165	135	170	1,150	920	222	405	291	222	210
21	246	296	160	140	175	1,190	740	248	370	276	248	235
22	416	296	155	145	170	1,540	440	262	338	262	248	222
23	367	284	160	145	175	1,440	370	276	388	306	262	128
24	322	285	150	155	175	1,390	338	276	660	405	222	248
25	308	285	155	145	160	830	405	354	785	306	210	262
26	469	274	160	150	180	580	423	306	920	276	150	235
27	505	322	180	160	170	580	388	405	920	291	235	276
28	416	264	165	135	160	458	354	405	700	262	248	262
29	264	274	170	160	......	405	440	338	580	222	248	262
30	335	264	150	185	......	405	492	322	510	248	248	162
31	308	......	145	155	......	405	......	338	......	248	276	......

NOTE.—Stage-discharge relation affected by ice Nov. 24, 25, and Dec. 11 to Mar. 20.

Monthly discharge of Sugar River near Brodhead, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 529 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	505	168	281	0.531	0.61
November	383	228	289	.546	.61
December	322	145	211	.399	.46
January	185	130	156	.295	.34
February	185	85	155	.293	.31
March	1,830	140	810	1.53	1.76
April	920	222	378	.715	.80
May	660	222	337	.637	.73
June	2,710	338	797	1.51	1.68
July	660	222	353	.667	.77
August	322	150	246	.465	.54
September	338	128	249	.471	.53
The year	2,710	85	356	.673	9.14

IOWA RIVER AT MARSHALLTOWN, IOWA.

LOCATION.—In T. 84 N., R. 18 W., at Third Avenue highway bridge, 1 mile north of Marshalltown, Marshall County, and about a mile below site of old gaging station.

DRAINAGE AREA.—1,380 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—May 21, 1915, to September 30, 1917; February 23, 1903, to August 8, 1903, for old site a mile above present station.

GAGE.—Chain gage attached to downstream handrail of bridge, 60 feet from right pier; read by B. S. Beehrle.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge, to which gage is attached.

CHANNEL AND CONTROL.—Bed of stream sandy and subject to change; right bank not subject to overflow; left bank will be overflowed at stages above 13 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 14.4 feet March 27 (discharge, 9,640 second-feet); minimum stage recorded, 2.32 feet October 9 (discharge, 56 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

ACCURACY.—Stage-discharge relation not permanent. One rating curve, well defined below 2,000 second-feet, used during 1917. Gage read once daily to hundredths. Daily discharge ascertained by applying daily gage height to rating table. Open-water records good.

Discharge measurements of Iowa River at Marshalltown, Iowa, during the year ending Sept 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 11[a]	C. Herlofson	2.56	134	June 26	Bolster and Herlofson	4.24	769
June 26	Bolster and Herlofson	4.24	775	Sept. 13	C. Herlofson	2.78	209

a Measurement made from a boat.

Daily discharge, in second-feet, of Iowa River at Marshalltown, Iowa, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	91	129	146		1,960	1,260	590	590	163	69
2	100	129	129		1,720	1,320	930	472	180	78
3	129	129	129		1,460	1,420	1,020	472	129	97
4	113	113	129		1,320	1,520	1,460	434	107	107
5	97	129	129		1,320	1,620	2,160	415	100	129
6	94	113	146		1,260	1,360	3,640	434	107	180
7	129	113	129		1,260	1,160	7,100	415	81	180
8	97	129	129		1,260	1,060	6,760	472	129	163
9	56	146	75		1,220	975	6,980	472	180	268
10	84	129	87		1,120	840	8,220	630	198	396
11	100	129	97		1,520	750	8,110	670	180	286
12	97	163	129		930	710	7,100	550	163	250
13	91	233	110		930	670	6,660	453	233	198
14	84	180	97		840	630	4,580	396	215	163
15	78	163	78		795	590	3,730	377	198	129
16	72	146	69		710	590	2,810	396	163	129
17	78	129			670	550	1,900	415	146	113
18	84	129		1,420	795	453	1,420	377	146	107
19	87	113		1,160	840	511	1,220	377	163	97
20	91	129		3,640	840	415	1,060	322	146	91
21	87	129		4,580	840	434	975	377	113	84
22	91	146		7,320	930	511	930	340	87	81
23	113	163		7,320	930	550	885	340	113	87
24	94	180		7,100	975	590	840	590	113	91
25	129	129		9,520	930	590	795	434	129	97
26	129	146		8,000	840	550	750	359	146	107
27	129	146		9,460	750	550	750	340	146	100
28	129	163		5,900	710	434	710	286	146	97
29	163	163		4,480	1,120	472	670	268	69	91
30	146	163		3,380	1,160	511	630	233	75	97
31	146			2,580		511		198	84	

Monthly discharge of Iowa River at Marshalltown, Iowa, for the year ending Sept. 30, 1917.

[Drainage area, 1,380 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	163	56	103	0.075	0.09
November	233	113	143	.104	.12
December 1-16	146	69	113	.082	.05
March 18-31	9,640	1,160	5,430	3.93	2.05
April	1,960	670	1,060	.768	.86
May	1,620	415	778	.564	.65
June	8,220	590	2,850	2.06	2.30
July	670	198	416	.301	.35
August	233	69	140	.101	.12
September	396	69	139	.101	.11

IOWA RIVER AT IOWA CITY, IOWA.

Location.—In T. 79 N., R. 6 W. at highway bridge about 500 feet below Chicago, Rock Island & Pacific Railway main-line bridge; about three-quarters of a mile below Iowa State University's power plant, three-quarters of a mile downstream from old gaging station, which was at county highway bridge a short distance above dam.

Drainage area.—3,140 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

Records available.—October 30, 1913, to September 30, 1917, at present site; June 11, 1903, to July 21, 1906, for old gaging station.

Gage.—Chain gage, attached to upstream handrail of bridge about 40 feet from left-hand end of first span from left bank; read by Ray Stramp, C. P. McGrath, and A. Kostal.

Discharge measurements.—Made from bridge to which gage is attached, or from a boat about 1,000 feet below highway bridge.

Channel and control.—Bed composed of sand; subject to change. Right bank high and will not be overflowed; left bank will be overflowed at high stage under a pile trestle approach to the bridge and beyond the left end of the approach at extremely high stage.

Extremes of discharge.—Maximum stage recorded during year, 8.8 feet June 7 (discharge, 6,950 second-feet); gage not read during high water June 9-22. Minimum stage recorded, −.50 foot December 26 (discharge, about 10 second-feet). Maximum stage ever recorded, about 15 feet (old gage) night of June 2-3, 1903 (discharge, about 20,000 second-feet); minimum discharge, about 10 second-feet December 26, 1916.

Ice.—Stage-discharge relation affected by ice; observations discontinued during winter.

Regulation.—Considerable diurnal fluctuations at low stages owing to operation of power plant above station.

Accuracy.—Stage-discharge probably permanent during year. Rating curve well defined between 142 and 11,000 second-feet. Gage read once daily to half-tenths. Daily discharge, except as noted below, ascertained by applying daily gage height to rating table. No gage readings available October 1-3, March 15 to April 10, and June 9-22; discharge estimated from record of discharge at Marshalltown. Records for periods in which discharge was estimated and in which it was less than 142 second-feet fair; records for periods of low water with marked diurnal fluctuation are of doubtful value; other records excellent.

Discharge measurements of Iowa River at Iowa City, Iowa, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 21	C. Herlofson	0.39	193	June 23	C. Herlofson	5.02	3,190
28	Students, University of Iowa	.78	340	Sept. 16	....do	.96	458
28	....do	.78	334				

Daily discharge, in second-feet, of Iowa River at Iowa City, Iowa, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug	Sept.
1	75	261	280	2,800 (1–10)	2,520	1,120	1,500	445	280
2	180	280	300		2,360	2,440	1,310	340	218
3	150	236	280		2,210	3,620	1,240	422	490
4	112	236	236		2,140	3,620	1,240	422	422
5	56	236	261		2,210	5,000	1,180	300	300
6	86	236	261		2,360	6,730	1,120	340	1,060
7	207	236	261		2,360	6,950	1,060	735	1,060
8	42	261	280		2,140	6,730	1,060	512	1,240
9	207	320	300		1,920	7,300 (9–22)	1,180	400	1,240
10	174	300	280		1,780		950	340	1,180
11	207	261	261	1,700	1,570		895	422	785
12	174	236	200	1,570	1,500		895	340	635
13	320	261	136	1,440	1,380		950	320	735
14	207	236	107	1,380	1,310		950	422	490
15	85	218	121	1,310	1,180		840	229	512
16	158	168	22	1,310	1,120		840	221	360
17	225	184	22	1,240	1,000		785	360	467
18	174	136	82	1,180	950		950	261	445
19	158	136	22	1,120	950		840	261	422
20	112	152	22	1,180	840		785	360	400
21	29	168	22	1,380	950		735	320	380
22	29	218	22	1,700	2,140		785	300	261
23	225	261	22	1,440	1,980	3,170	635	243	340
24	243	280	17	1,380	1,630	3,440	735	204	467
25	280	280	14	1,240	1,440	2,520	635	221	380
26	280	168	10	1,180	1,310	2,280	635	188	467
27	280	152	22	1,180	1,120	2,060	685	239	422
28	300	168	22	1,180	1,060	1,780	635	261	445
29	243	184	26	1,310	1,060	1,780	560	300	225
30	261	218	32	1,640	1,060	1,500	610	280	261
31	243	....	30	....	1,240	....	610	261	....

Monthly discharge of Iowa River at Iowa City, Iowa, for the year ending Sept. 30, 1917.

[Drainage area, 3,140 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	320	29	177	0.056	0.06
November	320	136	223	.071	.08
December	300	10	128	.041	.05
April	....	1,120	1,840	.586	.65
May	2,520	840	1,570	.500	.58
June	....	1,120	5,230	1.666	1.86
July	1,500	560	898	.286	.33
August	735	188	331	.105	.12
September	1,240	218	546	.174	.19

IOWA RIVER AT WAPELLO, IOWA.

LOCATION.—In sec. 27, T. 74 N., R. 3 W., at highway bridge about half a mile from railroad station at Wapello, Louisa County, and 20 miles from mouth of Iowa River. No large tributaries enter near station.

DRAINAGE AREA.—At gaging station, 12,480 square miles; at mouth, 12,600 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—February 26, 1915, to September 30, 1917.

GAGE.—Chain gage attached near center of first span from right abutment; read by C. W. Warren.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; shifts slightly. Right bank high and will not be overflowed; levee along left bank might break or be overtopped at extremely high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.2 feet, March 29 (discharge, 52,000 second-feet); minimum discharge, 400 second-feet December 15–17. Maximum known stage prior to 1917, about 14.3 feet about April 3, 1912 (discharge, about 58,000 second-feet). The flood of June, 1892, was much higher.

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation nearly permanent; one rating curve used during 1917, well defined throughout. Gage read once daily to hundredths. Daily discharge, except as noted below, ascertained by applying daily gage height to rating table. Stage-discharge relation affected by ice December 14 to March 9; discharge ascertained from one discharge measurement, observer's notes, gage heights, and weather records. Open-water records excellent; winter records fair.

Discharge measurements of Iowa River at Wapello, Iowa, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 20	C. Herlofson	0.52	1,080	Mar. 29	Davis and Herlofson	12.9	50,200
Jan. 3[a]	....do	.54	630	Sept. 18	C. Herlofson	.94	2,200

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Iowa River at Wapello, Iowa, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,700	1,630	1,770	650	1,000	1,000	30,200	10,500	5,510	13,900	3,790	1,840
2	1,630	1,770	1,770	650	900	1,000	24,200	11,500	6,220	13,200	3,400	1,840
3	1,630	1,770	1,700	650	800	1,000	19,600	10,800	9,880	10,200	3,210	2,210
4	1,560	1,770	1,700	650	700	1,000	18,000	9,880	12,200	9,260	2,850	3,030
5	1,440	1,770	1,700	650	700	1,000	12,800	11,200	14,600	8,360	3,030	3,990
6	1,370	1,630	1,700	650	700	1,000	14,600	11,200	21,700	8,070	2,850	4,620
7	1,370	1,630	1,700	650	600	1,000	10,500	10,500	24,700	7,510	5,060	5,980
8	1,310	1,630	1,700	700	600	1,000	9,570	9,260	25,600	7,510	5,280	9,570
9	1,370	1,770	1,630	800	600	1,500	9,260	8,660	26,500	8,070	3,990	6,980
10	1,370	1,770	1,500	800	600	3,400	8,960	8,660	26,500	6,980	3,030	4,840
11	1,370	1,840	1,370	900	600	4,400	8,660	7,510	25,600	5,980	2,850	4,190
12	1,370	1,840	1,250	900	600	5,510	8,360	6,720	26,000	4,840	2,850	3,210
13	1,310	1,840	830	900	600	7,510	7,790	6,470	27,400	6,720	3,030	2,850
14	1,310	1,910	500	800	600	15,700	7,510	5,740	32,700	6,470	3,030	2,850
15	1,310	1,910	400	700	600	19,200	6,980	5,510	43,500	5,980	3,030	2,680
16	1,310	1,840	400	700	600	15,700	6,980	5,060	41,200	5,510	3,030	2,680
17	1,250	1,910	400	700	600	16,900	6,980	4,840	38,500	5,510	2,850	2,680
18	1,250	1,500	500	700	700	19,200	6,470	4,620	33,200	5,510	2,680	2,520
19	1,310	1,500	500	700	700	15,700	6,470	4,620	25,600	5,510	2,680	2,210
20	1,370	1,560	600	700	700	13,500	6,470	4,400	21,300	5,060	2,680	2,140
21	1,440	1,630	600	700	800	12,200	6,720	4,400	17,700	4,840	2,680	2,060
22	1,440	1,770	600	800	1,000	9,880	6,470	6,720	12,800	5,060	2,680	1,980
23	1,370	1,980	700	900	1,000	10,500	6,470	10,800	10,500	5,280	2,520	1,980
24	1,560	1,980	700	800	1,000	13,200	6,470	8,960	11,800	5,510	2,360	1,980
25	1,630	1,840	700	700	1,000	15,000	6,470	7,240	10,500	5,060	2,210	1,910
26	1,980	1,910	700	700	1,000	15,700	6,470	6,220	9,260	4,840	2,210	1,840
27	1,910	1,700	700	700	1,000	18,000	6,470	5,740	8,360	4,840	2,140	1,770
28	1,840	1,630	700	800	1,000	24,700	6,220	5,510	8,660	4,840	1,980	1,770
29	1,770	1,630	650	900	....	48,300	6,470	5,060	9,880	4,620	1,910	1,910
30	1,700	1,630	650	1,000	....	45,900	7,240	5,510	12,200	4,190	1,910	1,770
31	1,630	....	650	1,000	....	35,800	....	5,060	....	3,790	1,910	....

Monthly discharge of Iowa River at Wapello, Iowa, for the year ending Sept. 30, 1917.

[Drainage area, 12,480 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,980	1,250	1,490	0.119	0.14
November	1,980	1,500	1,750	.140	.16
December	1,770	400	999	.080	.09
January	1,000	650	760	.061	.07
February	1,000	600	761	.061	.06
March	48,300	1,000	12,800	1.03	1.19
April	30,200	6,220	9,860	.790	.88
May	11,500	4,400	7,380	.591	.68
June	43,500	5,510	20,000	1.60	1.78
July	13,900	3,790	6,550	.525	.61
August	5,280	1,910	2,890	.232	.27
September	9,570	1,770	3,060	.245	.27
The year	48,300	400	5,690	.456	6.20

CEDAR RIVER AT JANESVILLE, IOWA.

Location.—In sec. 35, T. 91 N., R. 14 W., at Illinois Central Railroad bridge about a quarter of a mile below highway bridge and 3 miles above junction with Shellrock River.

Drainage area.—1,660 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

Records available.—April 26, 1905, to September 30, 1906; May 28, 1915, to September 30, 1917.

Gage.—Chain gage attached to upstream guardrail of bridge about the middle of left span; read by James Townsend.

Discharge measurements.—Made from upstream side of railroad bridge.

CHANNEL AND CONTROL.—Bed composed of gravel; slightly shifting. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.6 feet 8 a. m., March 24 (discharge, 21,200 second-feet); minimum stage recorded, 0.78 foot December 10, (discharge, 181 second-feet.)

1905–06 and 1915–1917: Maximum discharge, 22,600 second-feet March 28, 1906; minimum stage recorded, 0.75 foot, November 3, 1915 (discharge, 173 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

REGULATION.—May be slight diurnal fluctuation of water level owing to operation of power plant at Waverly, 9 miles above station.

ACCURACY.—Stage-discharge relation nearly permanent. Rating curve well defined throughout. Gage read once daily to hundredths. Daily discharge ascertained by applying daily gage height to rating table. Records excellent.

Discharge measurements of Cedar River at Janesville, Iowa, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Mar. 28	C. Herlofson	7.34	4,940
June 25	Bolster and Herlofson	12.55	17,000
Sept. 15	C. Herlofson	1.14	292

Daily discharge, in second-feet, of Cedar River at Janesville, Iowa, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	291	281	264		2,090	1,390	1,630	2,650	1,060	316
2	254	291	258		1,850	1,450	2,650	2,160	654	288
3	251	267	255		1,280	1,510	2,740	2,020	559	334
4	264	261	264		1,390	1,280	2,400	1,950	451	334
5	245	239	258		1,260	1,060	2,020	1,450	451	316
6	251	248	251		1,340	955	1,750	1,230	493	295
7	242	267	255		1,390	852	2,320	1,120	471	316
8	236	258	261		1,280	802	3,310	1,230	451	211
9	236	258	302		1,230	703	4,260	2,020	493	288
10	232	302	181		1,120	654	3,620	1,750	654	248
11	236	390	267		1,060	630	2,400	1,390	752	264
12	232	410	261		955	654	2,240	1,340	606	245
13	242	334			955	679	2,160	1,280	583	264
14	242	300			903	583	1,950	1,390	606	288
15	223	250			852	514	1,750	1,450	537	313
16	211	250			802	471	1,390	1,280	559	334
17	245	250			679	451	1,120	1,120	903	274
18	232	250			728	451	955	852	654	284
19	220	267			728	471	903	1,010	606	298
20	211	302			903	630	752	852	471	306
21	232	316			903	606	728	559	410	306
22	271	313			955	752	703	852	371	316
23	236	306		10,400	1,280	728	752	852	410	352
24	232	267		21,200	1,170	703	1,690	679	390	559
25	275	258		16,600	1,120	852	5,520	752	334	430
26	251	220		9,440	1,060	802	14,200	802	288	410
27	284	267		6,700	1,010	802	5,780	703	316	410
28	261	288		4,760	903	752	4,760	852	334	371
29	291	309		3,410	1,010	802	2,920	583	316	334
30	298	271		2,740	1,010	852	2,480	583	334	514
31	288			2,320		752		654	306	

Monthly discharge of Cedar River at Janesville, Iowa, for the year ending Sept. 30, 1917.

[Drainage area, 1,660 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	298	211	250	0.151	0.17
November	410	220	283	.170	.19
December 1-12	302	181	257	.155	.07
March 23-31	21,200	2,320	8,620	5.19	1.74
April	2,090	679	1,110	.669	.75
May	1,510	451	793	.478	.55
June	14,200	703	2,730	1.64	1.84
July	2,650	559	1,210	.729	.84
August	1,060	288	510	.307	.35
September	559	211	327	.197	.22

CEDAR RIVER AT CEDAR RAPIDS, IOWA.

LOCATION.—In T. 83 N., R. 7 W., in central part of Cedar Rapids, Linn County, about half a mile below dam, between electric-railroad bridge and Seventh Avenue combination railroad and footbridge.

DRAINAGE AREA.—At gaging station, 6,640 square miles; at junction with Iowa River, 7,930 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—October 26, 1902, to September 30, 1917.

GAGE.—Inclined staff gage fastened to posts driven in right bank of the river in rear of plant of the Iowa Windmill & Pump Co.; read by R. S. Toogood. Elevation of zero of gage from Northwestern Railroad levels, 723.03 feet above sea level.

DISCHARGE MEASUREMENTS.—Made from different bridges in the vicinity of the gage, according to the stage.

CHANNEL AND CONTROL.—Bed composed of rock and gravel; free from vegetation and practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 17.2 feet at 6 p. m., March 26 (discharge, 54,200 second-feet); minimum open-water stage recorded during year, 2.9 feet October 9–17 (discharge, 740 second-feet); minimum winter discharge much less.

1902–1917: Maximum stage recorded, 17.2 feet April 1, 1912, and March 26, 1917 (discharge, 54,200 second-feet); minimum open-water stage recorded, 2.5 feet July 24–28, 1911 (discharge, 410 second-feet); minimum during period of ice effect in December, 1916, probably much less. Greatest known flood probably occurred in June, 1851, when the maximum stage was about 20 feet, and the discharge about 65,000 second-feet.

ICE.—Stage-discharge relation affected by ice, except in very mild winters, when the swift current and the proximity to the power plant keep the measuring section open.

REGULATION.—Power has been developed at the new dam above the gaging station during 1917. There is no direct evidence yet of effect on gage readings. There is no dam for a long distance below Cedar Rapids and no backwater at gaging station.

ACCURACY.—Stage-discharge relation nearly permanent. Rating curve well defined. Gage read once daily, to tenths. Daily discharge ascertained by applying daily-gage height to rating table. Stage-discharge relation affected by ice December 14 to March 18; discharge estimated as 70 per cent of discharge at Wapello. Open-water records excellent; winter records fair.

COOPERATION.—Gage-height record furnished by United States Weather Bureau.

Discharge measurements of Cedar River at Cedar Rapids, Iowa, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 22	C. Herlofson............	3.31	1,300	Mar. 27	Herlofson and Davis...	15.40	44,900
Jan. 5[a]	....do................	3.31	456	Sept. 16	Herlofson and Clyde...	3.25	1,240

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet of Cedar River at Cedar Rapids, Iowa, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,020	1,180	1,020		10,800	4,730	2,770	7,890	1,960	1,100
2	870	1,180	1,020		8,970	4,730	2,770	6,820	1,840	1,100
3	870	1,020	1,020		8,250	5,070	5,420	5,770	1,840	1,100
4	870	1,020	1,020		7,170	5,770	6,120	5,770	1,840	1,100
5	870	1,020	1,020	900	6,820	5,770	8,970	5,070	1,630	1,100
6	870	1,020	1,020		6,120	5,420	9,340	5,070	1,630	1,100
7	870	1,020	1,020		5,770	5,070	10,100	4,730	1,630	1,630
8	870	1,020	1,020		5,420	4,730	10,800	4,050	1,630	1,630
9	740	1,020	1,020		5,420	4,390	10,100	3,720	1,630	1,630
10	740	1,020	870		5,070	4,050	11,600	3,720	1,630	1,260
11	740	870	870	4,050	5,070	3,390	13,900	4,050	1,630	1,260
12	740	870	870	3,720	4,730	3,070	15,400	4,390	1,840	1,260
13	740	1,020	870	4,730	4,730	3,070	18,000	4,050	1,960	1,260
14	740	1,180		7,890	4,050	2,770	15,400	3,720	1,840	1,440
15	740	1,020		8,610	3,720	2,480	10,800	3,390	1,840	1,260
16	740	870		8,610	3,720	2,480	8,970	3,390	1,840	1,260
17	740	870		6,820	3,390	2,210	7,890	3,390	1,840	1,260
18	870	870		5,070	3,070	2,210	6,820	3,390	1,630	1,260
19	870	1,020		4,050	2,770	1,960	5,770	3,070	1,630	1,260
20	870	1,020		3,390	3,070	1,960	4,730	3,070	1,630	1,260
21	870	1,180		4,730	3,070	1,840	4,390	3,070	1,630	1,100
22	870	1,350	400	6,820	3,070	1,960	3,720	3,070	1,630	1,100
23	870	1,180		10,100	3,390	2,480	4,050	3,070	1,440	1,100
24	870	1,180		10,800	3,720	2,480	3,720	3,070	1,440	1,100
25	1,020	1,020		24,500	4,050	2,480	3,390	3,390	1,260	1,100
26	1,180	1,020		52,600	4,050	2,210	3,720	3,390	1,260	1,100
27	1,020	1,180		47,400	3,720	2,480	6,120	3,390	1,260	1,100
28	1,020	1,180		35,200	3,390	2,770	7,170	3,070	1,100	1,100
29	1,020	1,180		24,500	3,720	2,480	13,100	2,770	1,100	1,100
30	1,180	1,180		17,800	4,050	2,480	10,800	2,480	1,100	1,100
31	1,180	....		13,900	....	2,770	....	2,210	1,100	....

NOTE.—Braced figures show mean discharge for period included.

Monthly discharge of Cedar River at Cedar Rapids, Iowa, for the year ending Sept. 30, 1917.

[Drainage area, 6,640 square miles]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,180	740	886	0.133	0.15
November	1,350	870	1,060	.160	.18
December	1,020		641	.097	.11
January			530	.079	.09
February			530	.079	.08
March	52,600		10,100	1.52	1.75
April	10,800	2,770	4,810	.725	.81
May	5,770	1,840	3,280	.494	.57
June	18,600	2,770	8,220	1.24	1.38
July	7,890	2,210	3,920	.590	.68
August	1,960	1,100	1,600	.241	.28
September	1,630	1,100	1,220	.184	.21
The year	52,600		3,070	.462	6.29

SHELLROCK RIVER NEAR CLARKSVILLE, IOWA.

LOCATION.—In T. 92 N., R. 16 W., at highway bridge 1¼ miles northwest of Clarksville, Butler County, and about 25 miles above junction with Cedar River. No large tributaries enter for several miles up and down stream.

DRAINAGE AREA.—1,660 square miles at station and 2,680 square miles at junction with Cedar River (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—May 28, 1915, to September 30, 1917.

GAGE.—Chain gage attached to handrail on upstream side of bridge 75 feet from right abutment; read by Mrs. H. H. Sherburne.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge to which gage is attached.

CHANNEL AND CONTROL.—Bed composed of rock and sand; probably permanent. Right bank high and will not be overflowed; left bank will probably be overflowed during extreme high stage.

EXTREMES OF DISCHARGE.—Maximum stage during year about 14.7 feet, March 22 (probably affected by ice); minimum stage recorded since station was established 1.15 feet October 23, 1916 (discharge, 125 second-feet). In April, 1907, a stage of about 16.5 feet was reached (discharge, about 19,000 second-feet).

ICE.—Stage-discharge relation affected by ice November 14–18, 25–26 and December 9 to about March 22; observations discontinued during winter.

ACCURACY.—Stage-discharge relation practically permanent, except as affected by ice. Rating curve well defined between 200 and 10,000 second-feet; not well defined outside these limits. Gage read once daily to hundredths. Daily discharge ascertained by applying daily gage height to rating table; estimated for period of ice effect. Records excellent except those for extremely low, and high stages, which are fair; winter records roughly approximate.

Discharge measurements of Shellrock River near Clarksville, Iowa, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Nov. 12	C. Herlofson	1.71	274
June 25	Bolster and Herlofson	5.01	2,660
Sept. 15	C. Herlofson	1.67	245

Daily discharge, in second-feet, of Shellrock River near Clarksville, Iowa, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	188	165	165	....	2,340	1,810	1,900	1,500	510	212
2	165	165	155	....	2,160	1,900	1,570	1,340	510	212
3	165	165	155	....	1,980	1,570	1,500	1,200	485	212
4	155	165	155	....	1,900	1,340	1,340	1,140	485	200
5	175	165	145	....	1,900	1,340	1,060	935	485	188
6	155	165	145	....	1,900	1,280	2,440	870	485	188
7	145	165	145	....	1,730	1,140	5,640	710	650	200
8	145	175	155	....	1,570	1,000	3,820	1,280	935	212
9	145	225	130	....	1,420	870	2,940	1,140	1,000	435
10	145	345	100	....	1,280	805	2,240	1,060	510	345
11	145	308	100	....	1,200	805	1,810	1,000	510	290
12	145	255	100	....	1,060	740	1,500	1,000	485	272
13	145	225	100	....	1,000	680	1,810	935	460	255
14	145	200	....	....	935	620	1,500	870	485	240
15	165	175	....	....	870	565	1,200	805	460	255
16	175	175	....	....	805	510	935	805	410	240
17	145	175	....	....	805	485	870	1,000	365	240
18	145	175	....	....	740	435	772	1,000	345	225
19	155	175	....	....	870	388	650	805	325	200
20	165	175	....	....	870	1,000	592	680	308	212
21	145	188	....	....	1,280	870	538	680	272	345
22	135	188	....	....	1,340	870	650	2,440	272	308
23	125	188	....	....	1,340	870	805	2,160	255	290
24	145	188	....	....	1,140	805	2,530	1,500	240	255
25	165	175	....	....	1,060	710	2,530	1,000	225	240
26	188	175	....	....	1,060	620	2,160	805	225	212
27	200	200	....	....	1,200	805	1,650	710	225	225
28	212	255	....	3,360	1,140	1,140	1,650	650	225	325
29	200	175	....	2,730	1,140	935	1,730	565	225	255
30	175	165	....	2,530	1,650	805	1,570	510	225	225
31	175	....	....	2,440	....	1,340	....	510	212	....

NOTE.—Observations of stage suspended Dec. 14 to Mar. 27 because of ice.

Monthly discharge of Shellrock River near Clarksville, Iowa, for the year ending Sept. 30, 1917.

[Drainage area, 1,660 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	212	125	161	0.097	0.11
November	345	165	195	.118	.13
December 1-13	165	....	132	.079	.04
March 28-31	3,360	2,440	2,760	1.66	.21
April	2,340	740	1,320	.795	.89
May	1,900	388	937	.565	.65
June	5,640	538	1,730	1.04	1.16
July	2,440	510	1,020	.614	.71
August	1,000	212	413	.249	.29
September	435	188	250	.151	.17

SKUNK RIVER AT COPPOCK, IOWA.

LOCATION.—In T. 74 N., R. 8 W., at highway bridge one-eighth mile above Chicago, Burlington & Quincy Railroad bridge and a quarter of a mile above junction with Crooked Creek.

DRAINAGE AREA.—2,890 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—October 21, 1913, to September 30, 1917.

GAGE.—Chain gage attached to downstream side of bridge; read by J. W. Ricks.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached.

CHANNEL AND CONTROL.—Bed composed of gravel and sand; channel shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 17.5 feet June 14 (discharge, 15,700 second-feet); minimum discharge recorded, 52 second-feet October 17.

Maximum stage prior to 1917 about 24 feet (discharge, 30,000 second-feet) about the end of May, 1903.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

ACCURACY.—Stage-discharge relation changed during the year, requiring the use of three rating curves applicable October 1–11, October 15 to November 26, and November 30 to September 30. The second rating curve, used during the rebuilding of piers of the Chicago, Burlington & Quincy Railroad bridge below the station, is not well defined; the other two curves are well defined. Discharge interpolated October 12–14 and November 27–29. Gage read once daily to hundredths. Daily discharge ascertained by applying daily gage height to rating table. Open-water records excellent.

Discharge measurements of Skunk River at Coppock, Iowa, during the year ending Sept. 30, 1917.

[Made by C. Herlofson.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Nov. 25 [a]	3.22	281	Sept. 19	2.76	144
July 13	4.56	771	19	2.77	144

[a] Stage-discharge relation affected by backwater caused by cofferdam used during construction of new piers at the Chicago, Burlington & Quincy Railroad bridge, one-eighth mile below gage.

Daily discharge, in second-feet, of Skunk River at Coppock, Iowa, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	228	145	265		1,120	7,360	1,360	1,760	422	157
2	203	135	250		940	7,2[illegible]0	1,960	1,620	388	146
3	168	135	250		885	3,8[illegible]0	5,470	1,420	355	310
4	157	120	238		785	3,920	6,740	1,300	340	2,720
5	135	118	238		835	5,260	8,810	1,180	325	785
6	[illegible]	116	214		885	4,020	12,900	1,120	295	560
7	115	114	214		785	3,290	14,200	995	480	520
8	119	116	238		785	2,640	12,900	940	690	690
9	115	433	202		785	2,330	11,000	940	340	370
10	111	469	190		885	2,040	9,810	940	310	238
11	109	364	179	4,420	885	1,900	9,090	1,060	265	214
12	101	270		2,500	835	1,620	8,670	885	265	226
13	92	242		2,960	835	1,420	8,950	785	250	238
14	83	256		7,230	785	1,300	15,400	690	250	214
15	75	270		5,800	735	1,180	15,000	690	238	202
16	75	228		3,830	735	1,120	13,900	600	226	179
17	52	178		5,150	885	1,000	13,000	645	226	168
18	55	145		4,020	885	885	12,200	785	214	157
19	58	125		3,460	1,560	835	11,300	785	214	146
20	89	114		4,020	1,680	785	9,960	940	214	146
21	77	112		4,420	1,240	735	8,260	995	214	135
22	72	111		3,040	1,300	6,260	6,620	785	202	135
23	69	156		2,330	1,060	5,040	5,360	690	190	131
24	111	215		2,720	995	3,920	4,120	995	190	129
25	770	331		2,640	1,360	2,560	3,040	690	179	129
26	430	300		2,640	1,240	2,040	2,480	690	179	135
27	93	288		2,640	995	1,760	2,3[illegible]0	835	179	146
28	215	275		2,640	885	1,560	2,040	735	179	129
29	202	268		2,640	2,640	1,360	1,960	600	168	122
30	190	250		1,760	2,960	1,240	2,100	520	168	118
31	167			1,300		1,490		460	157	

NOTE.—Stage-discharge relation affected by ice Dec. 12 to Mar. 10; data inadequate for determinations of discharge.

Monthly discharge of Skunk River at Coppock, Iowa, for the year ending Sept. 30, 1917.

[Drainage area, 2,890 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	770	52	150	0.052	0.06
November	469	111	213	.074	.08
December 1-11	265	179	226	.077	.03
March 11-31	7,230	1,300	3,440	1.19	.93
April	2,960	735	1,110	.384	.43
May	7,360	735	2,640	.913	1.05
June	15,400	1,360	8,030	2.778	3.10
July	1,760	460	906	.314	.36
August	690	157	268	.093	.11
September	2,720	118	323	.112	.13

SKUNK RIVER AT AUGUSTA, IOWA.

LOCATION.—In T. 69 N., R. 4 W., at highway bridge about one-third mile from Augusta post office, Des Moines County, and 12.2 miles from mouth of Skunk River, where it empties into pond of Mississippi River Power Co., 32.2 miles above dam at Keokuk, Iowa.

DRAINAGE AREA.—At gaging station 4,200 square miles; at mouth 4,350 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—September 30 to November 15, 1913; May 27, 1915, to September 30, 1917.

GAGE.—Chain gage attached to downstream handrail of bridge about 95 feet from left abutment; read once daily by L. E. Williamson. Staff gage attached to downstream left side of middle pier, used by engineers of the Hydraulic Engineering Co. of Maine during 1913; datum of gage about 0.73 foot higher than that of chain gage; taken out by ice in spring of 1914.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached.

CHANNEL AND CONTROL.—Bed of stream sandy and subject to change; right bank high and will not be overflowed; left bank will only be overflowed at extremely high stage; remains of old mill dam 600 feet below gage will probably make stage-discharge relation permanent. The riffle at the dam causes a drop of 3 feet at medium low stage. Backwater from the Mississippi can not occur oftener than once in about 50 years.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 17.0 feet June 7; minimum stage recorded, 1.20 feet September 24.

Maximum stage prior to 1917 approximately 21 feet about June 1, 1903 (discharge, nearly 40,000 second-feet); minimum discharge recorded, 63 second-feet November 10, 1913; absolute minimum discharge at this station probably 25 second-feet or less.

ICE.—Stage-discharge relation affected by ice December 14 to March 12.

Data inadequate for determination of discharge.

Discharge measurements of Skunk River at Augusta, Iowa, during the year ending Sept. 30, 1917.

[Made by C. Herlofson.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Oct. 17	1.63	83	July 12	2.94	1,130
Jan. 19 [a]	2.10	140	Sept. 20	2.02	191
June 11	10.65	12,400			

[a] Measurement made under ice cover.

Daily gage height, in feet, of Skunk River at Augusta, Iowa, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.18	1.95	2.45	2.4	......	2.55	3.4	11.9	4.2	9.8	2.8	1.8
2	2.13	1.90	2.35	......	2.85	2.6	3.4	10.9	5.1	3.6	2.7	1.75
3	1.93	1.90	2.17	2.10	2.8	2.55	3.35	9.3	5.5	3.5	2.55	2.35
4	1.73	1.87	2.13	2.4	2.8	2.00	3.25	6.8	8.9	3.4	2.65	2.4
5	1.68	1.85	1.97	......	2.6	......	3.1	8.0	14.0	3.15	2.65	4.4
6	1.63	1.90	1.92	2.3	2.5	......	3.05	7.6	16.4	3.05	2.17	3.8
7	1.63	2.11	1.75	2.4	......	......	3.0	6.0	17.0	3.0	2.45	3.6
8	1.58	1.95	1.77	2.45	2.07	......	3.25	5.6	16.6	2.95	2.5	3.6
9	1.53	2.75	1.72	......	2.02	......	3.3	4.8	16.2	3.15	3.1	3.0
10	1.58	2.85	1.72	2.5	2.02	......	3.4	4.6	14.3	3.1	2.55	2.9
11	1.58	2.85	1.77	......	2.02	2.4	3.4	4.3	11.5	3.05	2.5	2.45
12	1.48	2.75	1.70	3.1	......	5.4	3.35	4.1	10.0	3.1	2.25	2.05
13	1.53	2.55	1.77	3.05	2.05	5.4	3.4	4.0	13.4	3.05	2.17	2.2
14	1.58	2.3	1.82	2.9	2.02	11.0	3.4	3.8	12.2	2.4	2.17	2.25
15	1.48	2.15	......	......	......	10.0	3.3	3.6	12.8	2.7	2.17	2.2
16	1.43	2.05	1.87	2.75	2.02	8.4	3.15	3.5	14.6	2.6	2.17	2.25
17	1.48	1.95	1.77	2.5	2.02	7.6	3.6	3.4	14.2	2.55	2.17	2.2
18	1.53	1.95	1.82	......	2.07	7.0	3.6	3.4	12.6	2.6	1.97	2.2
19	1.63	1.80	......	1.95	2.2	6.5	3.6	3.4	12.2	2.95	1.97	2.15
20	1.65	1.97	1.87	1.82	2.12	5.2	4.1	3.1	10.0	3.0	1.87	1.85
21	1.68	1.96	......	1.82	2.12	5.0	4.1	6.2	9.3	2.95	2.17	1.80
22	1.33	2.00	1.87	......	2.17	4.8	4.0	10.0	8.6	2.95	1.97	1.55
23	1.58	2.05	1.87	5.2	......	4.7	3.8	9.0	7.2	3.05	2.17	1.25
24	1.73	2.00	1.87	4.4	2.2	4.6	3.8	6.6	6.4	3.0	2.17	1.20
25	2.6	1.75	1.82	......	2.4	4.6	4.3	5.2	5.8	2.95	2.3	1.25
26	3.05	1.85	......	4.3	2.45	4.5	4.0	5.1	5.4	2.75	1.67	1.30
27	3.05	2.3	1.92	3.2	......	4.4	3.8	5.1	4.6	2.7	2.17	2.00
28	3.0	2.45	1.97	2.95	......	4.2	3.8	5.0	4.4	3.0	2.17	1.87
29	2.75	2.65	2.02	......	......	4.0	4.2	5.0	4.2	2.95	2.17	1.92
30	2.25	2.55	2.02	2.85	......	3.6	5.6	4.1	4.2	3.0	2.3	1.90
31	2.03	......	2.12	2.8	......	3.5	......	4.1	......	2.55	2.17	......

DES MOINES RIVER AT KALO, IOWA.

Location.—In sec. 17, T. 88 N., R. 28 W., at highway bridge at Kalo, Webster County, about 1½ miles east of Otho, a station on Minneapolis & St. Louis Railroad, and 1½ miles above mouth of Holiday Creek, which enters from left.

Drainage area.—4,170 square miles (measured on map issued by United States Geological Survey, scale 1 to 500,000).

Records available.—October 18, 1913, to September 30, 1917, except October, 1914, to March 21, 1915, when the station was temporarily discontinued.

Gage.—Chain gage attached to downstream side of bridge in middle of right span; read by S. C. Fuller.

Discharge measurements.—At high stages made from bridge to which gage is attached; at low stages by wading.

Channel and control.—No well-defined control; channel consists of gravel and is fairly permanent; point of zero flow estimated to be at gage height −1.0 foot.

Extremes of discharge.—Maximum stage recorded during year 12.9 feet March 22 (discharge, 17,100 second-feet); minimum stage recorded since establishment of station, 0.25 foot October 12, 1916 (discharge, 66 second-feet).

1913–1917: Maximum stage recorded, 14.0 feet May 30, 1915 (discharge, 18,500 second-feet).

Ice.—Stage-discharge relation affected by ice November 14–18, 24–26, December 9 to March 21; observations discontinued during winter.

Accuracy.—Stage-discharge relation permanent throughout year except as affected by ice. Rating curve well defined between 200 and 12,000 second-feet; extended below 200 second-feet and only roughly approximate. Gage read once daily to quarter tenths. Daily discharge ascertained by applying daily gage height to rating table; estimated November 14–18, 24–26, because of ice. Records excellent except those below 200 second-feet, which are roughly approximate.

Discharge measurements of Des Moines River at Kalo, Iowa, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Nov. 10	C. Herlofson	0.88	270
June 27	Bolster and Herlofson	4.22	2,880
Sept. 14	Herlofson and Clyde	.76	219

Daily discharge, in second-feet, of Des Moines River at Kalo, Iowa, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	76	196	216		6,400	4,110	3,100	2,520	742	180
2	128	216	196		5,800	3,980	3,340	2,200	615	178
3	76	128	196		5,210	3,850	3,340	1,640	445	180
4	76	100	196		5,070	3,850	3,590	1,640	420	128
5	76	100	196		5,070	3,850	3,850	1,640	585	144
6	76	160	178		4,650	3,590	7,810	1,820	258	180
7	76	160	160		4,510	3,220	9,820	2,000	525	370
8	100	370	160		4,510	2,860	11,000	2,000	470	260
9	160	280	150		4,510	2,630	9,990	2,630	498	302
10	196	347			4,510	2,410	8,970	2,630	555	236
11	76	302			4,370	2,200	8,290	2,300	498	236
12	66	236			3,980	2,000	7,650	2,000	498	236
13	76	196			3,720	1,820	7,330	1,820	470	178
14	76	150			3,460	1,730	6,700	1,640	128	196
15	196	100			3,220	1,640	5,950	1,640	445	196
16	160	100			2,980	1,480	5,210	1,560	280	178
17	128	100			2,860	1,480	4,650	1,480	302	160
18	128	300			2,740	1,320	4,110	1,400	325	160
19	88	325			2,630	1,320	3,590	1,320	280	160
20	88	280			2,630	1,180	3,220	1,150	260	178
21	76	280			2,630	1,400	2,980	1,110	280	178
22	100	258		15,100	2,980	2,000	2,860	1,110	302	196
23	128	280		14,800	3,100	2,520	2,740	1,040	280	196
24	100	250		14,200	2,980	2,860	2,630	1,320	236	178
25	76	250		13,300	2,860	3,100	2,740	1,910	236	178
26	160	250		12,400	2,860	3,100	2,630	1,250	196	178
27	178	236		11,500	2,740	2,860	2,860	1,040	178	178
28	160	236		10,500	2,630	2,630	2,980	905	178	258
29	128	258		9,480	2,980	2,630	3,100	840	196	196
30	100	236		8,290	3,460	2,630	3,100	678	196	196
31	128			7,330		2,630		645	178	

Monthly discharge of Des Moines River at Kalo, Iowa, for the year ending Sept. 30, 1917.

[Drainage area, 4,170 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	196	66	111	0.027	0.03
November	347	100	215	.051	.06
December 1-9	216	150	183	.044	.01
March 22-31	15,100	7,330	11,700	2.81	.9[illegible]
April	6,400	2,630	3,740	.897	1.00
May	4,110	1,180	2,540	.609	.70
June	11,000	2,630	5,000	1.20	1.34
July	2,630	645	1,580	.379	.44
August	742	128	357	.086	.10
September	370	128	198	.047	.05

DES MOINES RIVER AT DES MOINES, IOWA.

LOCATION.—In T. 78 N., R. 24 W., at Walnut Street Bridge at Des Moines, Polk County, about one-third mile above mouth of Raccoon River and 205 miles above mouth of Des Moines River.

DRAINAGE AREA.—6,180 square miles. Effective area at high stages, including Raccoon River, 9,770 square miles (measured on map issued by United States Geological Survey; scale 1 to 500,000).

RECORDS AVAILABLE.—October 2, 1902, to August 3, 1903; October 1, 1914, to September 30, 1917, at the Walnut Street Bridge. From May 26, 1905, to July 20, 1906, records were collected at the Interurban Bridge near Highland Park, about 5 miles above present station. The United States Weather Bureau has maintained a gage at the Locust Street Bridge from July 1, 1897, to January, 1912; and at the Walnut Street Bridge from January, 1912, to September 30, 1917.

GAGE.—The original Weather Bureau gage is a staff gage at the Locust Street Bridge; one block above the Walnut Street Bridge. In January, 1912, a Friez water-stage recorder was installed by the United States Weather Bureau in and near the south end of the second pier from the east abutment of the Walnut Street Bridge. This gage is set to read the same as Locust Street gage. A copper float in a 9-inch pipe connects with the register at the top, which is graduated to record graphically stages from 0 to 33 feet. Gage zero is 774.74 feet above sea level.

DISCHARGE MEASUREMENTS.—Made at any one of several bridges below the power dam, according to the stage. Channel satisfactory for accurate measurements.

CHANNEL AND CONTROL.—A sheet-piling dam was constructed about 300 feet above the old mouth of Raccoon River about September, 1913. This dam, called a "beauty dam," is for the purpose of raising the low-water stage of the river a few feet and thus improving the appearance of the river through the park along the bank. The pooled water from this dam extends past the gage to the power dam at low water. The dam thus forms a fairly permanent control at low stages. It is drowned out at stages of 8 to 10 feet, depending on the stage in Raccoon River. Dam is now in poor repair and the stage-discharge relation has been affected thereby.

EXTREMES OF STAGE.—Maximum stage recorded during year, 16.1 feet June 10; minimum stage recorded, 1.3 feet in January.

1897–1917; maximum stage recorded, 22.6 feet, May 31, 1903; minimum stage recorded, 0.8 foot at various times.

ICE.—The effect of the power dam above the station is to improve the conditions of winter flow, but severe winters and occasional ice jams below the gage often seriously affect the stage-discharge relation.

REGULATION.—The Edison Power & Light Co.'s dam, about one-fourth mile above gage, causes slight diurnal fluctuation of stage. The dam is practically drowned out at a stage of 18 feet, although there is a perceptible ripple with a stage of 21 or 22 feet.

COOPERATION.—The gage-height records are furnished by the United States Weather Bureau.

Determinations of discharge withheld for additional data.

Discharge measurements of Des Moines River at Des Moines, Iowa, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Nov. 9	C. Herlofson	2.00	362
June 28	Bolster and Herlofson	5.58	3,890
Sept. 12	C. Herlofson	2.37	359

Daily gage height, in feet, of Des Moines River at Des Moines, Iowa, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.0	2.0	2.0	1.3	......	......	7.9	6.1	5.3	5.5	3.0	2.1
2	2.0	2.0	2.0	1.3	......	......	7.2	6.6	5.7	5.4	3.0	2.1
3	2.0	2.0	2.0	1.3	......	......	6.8	6.8	6.2	5.0	3.0	2.1
4	1.9	2.0	2.0	1.3	......	......	6.6	6.8	6.0	4.8	2.9	2.4
5	1.9	2.0	2.0	1.4	......	......	6.5	6.8	7.5	4.6	2.8	2.2
6	1.9	2.0	2.0	1.4	......	......	6.5	6.6	10.2	4.5	2.7	2.1
7	1.9	1.9	2.0	1.3	......	......	6.5	6.5	13.2	4.4	2.6	2.2
8	1.8	1.9	2.0	1.4	......	......	6.4	6.1	15.1	4.4	2.6	2.3
9	1.8	2.0	2.0	1.4	......	......	6.2	5.7	15.7	4.7	2.7	2.3
10	1.8	2.0	1.7	1.4	......	......	6.3	5.4	16.1	5.0	2.8	2.5
11	1.8	2.1	1.8	1.5	......	......	6.4	5.1	15.9	5.0	2.7	2.6
12	1.8	2.3	1.6	1.4	......	......	6.2	4.9	14.3	4.9	2.6	2.5
13	1.8	2.3	1.6	1.4	......	4.8	5.9	4.7	13.0	4.7	2.7	2.4
14	1.8	2.2	1.6	1.3	......	5.7	5.7	4.5	12.4	4.5	2.6	2.4
15	1.8	1.8	1.6	1.3	......	5.0	5.6	4.4	10.5	4.4	2.6	2.4
16	1.8	1.9	1.7	1.3	......	4.4	5.4	4.2	9.0	4.3	2.5	2.3
17	1.8	2.0	1.6	1.3	......	4.0	5.2	4.1	8.2	4.3	2.5	2.3
18	1.8	2.1	1.6	1.3	......	3.8	5.2	4.0	7.5	4.2	2.5	2.3
19	1.8	2.2	1.7	1.4	......	3.5	5.0	3.9	7.0	4.0	2.4	2.3
20	1.9	2.1	1.7	1.4	......	4.5	5.0	3.8	6.5	3.9	2.4	2.2
21	1.8	2.2	1.6	1.4	......	5.6	5.1	3.9	6.2	3.8	2.3	2.1
22	1.9	2.2	1.6	1.4	......	6.3	5.6	4.1	5.9	3.7	2.4	2.1
23	1.8	2.2	1.6	1.4	......	9.2	5.6	4.8	5.7	3.6	2.4	2.0
24	1.9	2.2	1.6	1.4	......	10.6	5.6	5.3	5.5	3.5	2.3	1.9
25	1.9	2.1	1.4	1.4	......	12.0	5.4	5.4	5.4	3.5	2.4	1.9
26	1.9	1.9	1.4	1.4	......	13.2	5.3	5.4	5.3	3.6	2.3	1.9
27	1.9	1.9	1.4	1.4	......	13.0	5.2	5.4	5.5	3.6	2.2	1.9
28	2.0	2.0	1.4	1.4	......	12.2	5.2	5.4	5.5	3.6	2.2	1.7
29	2.0	2.1	1.4	1.4	......	10.9	5.4	5.2	5.6	3.4	2.1	1.7
30	2.0	2.1	1.4	......	......	9.8	5.7	5.1	5.6	3.3	2.1	1.6
31	2.0	......	1.4	......	......	8.8	......	5.1	......	3.1	......	......

DES MOINES RIVER AT OTTUMWA, IOWA.

Location.—At Market Street Bridge, Ottumwa, Wapello County. No large tributary within several miles up or down stream.

Drainage area.—13,200 square miles (measured on map issued by the United States Geological Survey; scale, 1 to 500,000).

Records available.—Fragmentary high-water observations 1902–1916; daily records March 29 to September 30, 1917.

Gage.—Chain gage attached to downstream handrail of bridge. Staff gage painted on northeast face of north pier used prior to August 2, 1917.

Discharge measurements.—Made from Vine Street Bridge about 1,500 feet below gage.

Channel and control.—Channel probably fairly permanent.

Extremes of discharge.—Maximum stage recorded during the year, 16.5 feet June 11; minimum stage recorded, 1.5 feet September 25–30.

Maximum discharge since 1850 and probably in the last century occurred May 31, 1903, and exceeded 100,000 second-feet.

Ice.—Stage-discharge relation seriously affected by ice.

Cooperation.—Gage-height record obtained by the United States Weather Bureau.

Data inadequate for determination of discharge.

Discharge measurements of Des Moines River at Ottumwa, Iowa, for the period Sept. 18, 1914, to Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1914.		*Feet.*	*Sec.-ft.*	1917.		*Feet.*	*Sec.-ft.*
Sept. 18	Bolster and Davis	10.60	24,400	June 29	Bolster and Herlofson	5.32	8,070
				Aug. 1	C. Herlofson	2.60	1,960
1915.				Sept. 6	do	4.48	6,200
June 1	A. Davis	15.96	56,300				

Daily gage height, in feet, of Des Moines River at Ottumwa, Iowa, for the year ending Sept. 30, 1917.

Day.	Mar.	Apr.	May.	June.	Aug.	Sept.	Day.	Mar.	Apr.	May.	June.	Aug.	Sept.
1		8.3	7.6	4.7	2.6	1.7	16		5.1	4.9	13.5	2.1	2.1
2		7.1	7.5	6.5	2.6	1.6	17		5.1	4.8	12.5	2.1	2.1
3		6.5	6.5	8.9	2.5	1.6	18		5.0	4.7	8.5	2.0	2.1
4		6.1	7.6	8.4	2.5	1.6	19		4.9	4.6	8.3	1.8	2.0
5		6.0	8.3	10.7	2.3	1.6	20		4.8	4.5	7.1	1.8	2.0
6		5.8	7.5	11.7	2.3	3.0	21		4.8	4.4	6.7	1.8	1.8
7		5.3	7.7	13.3	2.3	5.0	22		4.7	4.6	6.3	1.8	1.8
8		5.3	6.9	13.8	2.2	4.8	23		4.7	4.7	5.9	1.8	1.6
9		5.3	6.2	13.9	2.2	3.8	24		4.9	4.5	5.6	1.8	1.6
10		5.3	5.6	16.0	2.2	2.8	25		5.0	4.7	5.3	1.8	1.5
11		5.2	5.5	16.5	2.2	2.4	26		4.9	4.8	5.1	1.8	1.5
12		5.2	5.3	15.6	2.1	2.3	27		4.9	4.8	4.9	1.7	1.5
13		5.1	5.2	16.2	2.1	2.3	28	9.9	4.9	4.7	5.5	1.7	1.5
14		5.1	5.1	15.6	2.1	2.3	29	10.3	5.0	4.7	5.3	1.7	1.5
15		5.1	5.0	14.6	2.1	2.2	30	10.1	5.8	4.7	5.3	1.7	1.5
							31	9.3		4.7		1.7	

DES MOINES RIVER AT KEOSAUQUA, IOWA.

LOCATION.—In sec. 36, T. 69 N., R. 10 W., at county bridge, Keosauqua, Van Buren County, a quarter of a mile above old dam site and Government locks. No large tributary enters Des Moines River for several miles up or down stream.

DRAINAGE AREA.—At gaging station, 13,900 square miles; at mouth, 14,300 square miles (revised measurements made from map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—May 30, 1903, to July 21, 1906; April 5 to December 31, 1910 (United States Engineer Corps); August 3, 1911, to September 30, 1917.

GAGE.—Chain gage attached to upstream handrail of bridge; read by Frank Schreckengast.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached.

CHANNEL AND CONTROL.—Channel shifts considerably at flood stages. Control is a gravel riffle about one-fourth mile below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 18.45 feet June 14 (discharge, 60,500 second-feet); minimum stage recorded, 0.10 foot, several days in October (discharge, 330 second-feet).

Maximum stage since 1850 and probably in the last century, 27.9 feet June 1, 1903 (discharge, 97,000 second-feet); maximum stage June 1, 1851, about 24 feet (discharge, about 80,000 second-feet).

1903–1917: Minimum stage recorded, zero, August 28 to September 6, 1911 (discharge, 160 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation fairly permanent for low and medium stages. Two fairly well defined rating curves were used. Gage read once daily to half-tenths. Stage-discharge relation affected by ice December 13 to March 9; discharge estimated from observer's notes and weather records. Open-water records good; winter records roughly approximate.

Discharge measurements of Des Moines River at Keosauqua, Iowa, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Nov. 8	Herlofson and Barber	0.38	630
June 30	Bolster and Herlofson	3.54	8,280
Aug. 2	C. Herlofson	1.02	2,030

Daily discharge, in second-feet, of Des Moines River at Keosauqua, Iowa, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	485	529	725				17,900	19,900	5,500	8,050	1,930	1,190
2	485	588	858				14,100	17,200	11,200	7,780	1,930	1,190
3	540	588	790				11,800	12,900	27,700	7,240	1,840	1,110
4	660	588	790				10,600	20,300	27,300	6,700	1,930	1,190
5	725	564	790			600	9,430	21,300	41,900	5,640	1,930	1,110
6	660	529	725				8,850	18,900	46,700	5,380	1,930	1,420
7	600	529	725				8,280	16,600	41,100	4,880	1,930	6,700
8	660	600	725				8,280	14,100	40,000	4,630	1,930	6,150
9	790	725	600				8,280	11,800	41,500	4,390	1,760	4,670
10	660	725	564			1,290	8,280	10,000	45,900	4,390	1,670	3,6[illegible]0
11	540	725	540		350	1,770	8,000	8,850	50,800	4,390	1,670	2,110
12	485	660	540			2,300	8,000	7,720	48,900	4,630	1,670	2,110
13	430	660				3,940	8,280	7,160	55,900	4,880	1,670	2,110
14	430	660				9,430	7,720	6,320	58,100	4,630	1,670	1,930
15	380	995				12,300	7,160	5,770	51,200	4,390	1,590	1,670
16	330	1,220		400		11,500	6,600	4,970	37,500	4,150	1,590	1,590
17	330	790				12,000	6,600	4,710	29,200	4,150	1,590	1,500
18	388	725				10,900	6,040	4,190	19,200	4,150	1,500	1,420
19	430	725				9,720	6,880	3,940	16,200	4,150	1,500	1,420
20	380	725				7,160	6,040	3,700	13,700	3,680	1,500	1,420
21	330	790	300			5,500	5,500	3,460	12,100	3,440	1,500	1,270
22	330	790				7,720	5,500	12,900	10,600	3,440	1,420	1,190
23	330	858				11,800	5,500	7,160	10,300	3,440	1,420	1,190
24	330	925				12,900	6,600	4,710	9,430	3,010	1,590	1,110
25	430	858				17,900	6,880	6,600	8,320	3,440	1,500	1,190
26	430	790			500	19,900	6,600	6,600	7,780	3,010	1,500	1,270
27	540	790				22,000	6,600	6,320	7,240	3,220	1,420	1,110
28	485	790				24,100	6,040	6,040	10,300	3,010	1,420	1,110
29	518	660				25,500	10,000	6,040	8,590	2,800	1,340	1,110
30	540	660			......	25,200	14,100	6,040	8,320	2,700	1,270	1,110
31	540	......			......	22,000	......	6,600	......	2,200	1,190	......

Monthly discharge of Des Moines River at Keosauqua, Iowa, for the year ending Sept. 30, 1917.

[Drainage area, 13,900 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	790	330	490	0.035	0.04
November	1,220	529	725	.052	.06
December	858	....	454	.033	.04
January	....	....	400	.029	.03
February	....	....	382	.027	.03
March	25,500	....	9,100	.655	.74
April	17,900	5,500	8,350	.600	.67
May	21,300	3,460	9,450	.679	.78
June	58,100	5,500	26,700	1.92	2.14
July	8,050	2,200	4,390	.316	.36
August	1,930	1,190	1,620	.117	.13
September	6,700	1,110	1,890	.136	.15
The year	58,100	....	5,330	.383	5.17

RACCOON RIVER AT VAN METER, IOWA.

LOCATION.—In SW. ¼ sec. 22, T. 78 N., R. 27 W., at highway bridge about one-third mile from railroad station, 1 mile below South Raccoon River, and 30 miles above junction of Raccoon River with Des Moines River.

DRAINAGE AREA.—At gaging station, 3,410 square miles; at mouth, 3,590 square miles (measured on map issued by United States Geological Survey, scale 1 to 500,000).

RECORDS AVAILABLE.—April 25, 1915, to September 30, 1917.

GAGE.—Chain gage attached to downstream handrail of bridge about 25 feet from right end of bridge; read by Fred Vreeland.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached.

Channel and control.—Bed composed of sand; subject to change. River divided into two channels at low and medium stages by an island; water surface slightly higher in the left channel than in the right at extreme low water; right bank high and not subject to overflow; left bank subject to overflow at a stage of about 13 feet. At extremely high stage this overflow will extend for several thousand feet beyond left end of bridge.

Extremes of discharge.—Maximum stage recorded during year, 17.5 feet June 7 (discharge, 31,800 second-feet); minimum stage, 1.83 feet October 12 and 17 (discharge, 64 second-feet).

1915–1917. Maximum stage recorded, June 7, 1917; minimum stage recorded 1.8 feet August 29, 1916 (discharge, 60 second-feet).

Ice.—Stage-discharge relation affected by ice November 14–20 and December 10 to March 19. Observations discontinued December 13 to March 13.

Accuracy.—Stage-discharge relation permanent throughout year. Rating curve well defined between 155 and 15,000 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying gage height to rating table; estimated November 14–20 because of ice. Open-water records excellent, except those for extremely low stages, which are fair.

Discharge measurements of Raccoon River at Van Meter, Iowa, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Nov. 10	C. Herlofson	2.41	236
June 28	Bolster and Herlofson	5.22	2,360
Sept. 13	Herlofson and Clyde	2.87	457

Daily discharge, in second-feet, of Raccoon River at Van Meter, Iowa, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	275	202	252	....	2,290	3,080	1,520	1,840	375	140
2	222	134	214	....	1,840	3,300	1,930	1,520	350	116
3	149	134	202	....	1,600	3,400	2,200	1,280	350	107
4	149	134	198	....	1,210	3,960	2,880	1,140	400	2,580
5	190	134	206	....	1,440	4,200	6,400	1,060	375	1,280
6	143	119	190	....	1,520	3,960	12,000	995	350	660
7	81	114	173	....	1,600	3,400	31,800	995	325	790
8	72	183	155	....	1,520	3,080	14,300	855	300	995
9	72	266	83	....	1,520	2,580	15,600	855	350	995
10	75	244	....	....	1,680	2,290	28,000	925	425	1,060
11	72	275	....	....	1,760	1,930	15,400	995	375	758
12	64	325	....	....	1,680	1,680	11,200	855	325	565
13	72	300	....	....	1,600	1,520	14,300	855	375	425
14	74		....	....	1,520	1,360	10,200	790	350	325
15	91		....	....	1,210	1,210	6,680	725	300	325
16	69		....	....	1,210	1,060	4,810	725	300	266
17	64	250	....	....	1,060	1,060	3,300	822	325	375
18	68		....	....	1,060	995	3,300	725	275	325
19	72		....	....	1,140	925	2,880	660	262	275
20	81		....	4,320	1,210	855	2,380	565	252	266
21	91	275	....	4,810	2,110	855	2,200	535	218	206
22	104	266	....	6,680	2,020	1,930	1,930	480	252	149
23	81	275	....	9,540	1,930	3,080	1,840	628	325	155
24	91	210	....	7,260	2,380	2,110	1,680	1,280	300	210
25	149	95	....	7,700	1,930	1,760	1,520	995	275	190
26	119	275	....	8,000	1,600	1,520	1,440	692	198	187
27	152	275	....	8,450	1,440	1,360	1,360	595	101	172
28	162	230	....	8,000	1,360	1,210	2,200	508	239	149
29	187	257	....	6,400	2,980	1,140	2,480	452	226	190
30	266	222	....	3,620	2,980	1,140	2,200	400	180	172
31	222	....	....	2,680	....	1,360	....	350	172	....

Monthly discharge of Raccoon River at Van Meter, Iowa, for the year ending Sept. 30, 1917.

[Drainage area, 3,410 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	275	64	122	0.036	0.04
November	325	95	223	.065	.07
December 1-9	252	83	186	.055	.02
March 20-31	9,540	2,680	6,460	1.89	.73
April	2,980	1,060	1,680	.493	.55
May	4,200	855	2,040	.600	.69
June	31,800	1,360	7,000	2.05	2.29
July	1,840	480	842	.247	.30
August	425	101	298	.087	.10
September	2,580	107	480	.141	.16

ILLINOIS RIVER AT PEORIA, ILL.

Location.—In sec. 2, T. 8 N., R. 8 E., at foot of Grant Street, Peoria, Peoria County, about 3½ miles above station formerly maintained at Peoria & Pekin Union Railroad bridge and 4½ miles above mouth of Kickapoo Creek.

Drainage area.—Not measured.

Records available.—March 8, 1910, to September 30, 1917; also March 10, 1903, to July 21, 1906, for station at Peoria & Pekin Union Railroad bridge.

Gage.—Vertical staff gage attached to wooden pile; read by employee of United States Army Engineers.

Discharge measurements.—Made from downstream side of Lower Free bridge, about 2 miles below gage.

Channel and control.—Bed of river, which forms control for medium and high stages, is mud and may shift. Dam at Copperas Creek probably forms control for lowest stages; permanent.

Extremes of discharge.—Maximum stage recorded during year, 18.4 feet June 15–17 (discharge, 34,800 second-feet); minimum stage, 10.0 feet October 1–4, 7–8, 10–18, and 20 (discharge, 10,000 second-feet).

1910–1917: Maximum stage recorded, 23.2 feet January 25, 1916 (discharge not determined because of backwater from ice); maximum open-water stage recorded, 22.4 feet March 30 to April 2, 1913 (discharge, 55,000 second-feet); minimum stage, 8.0 feet December 14, 1910 (discharge, 7,250 second-feet).

The highest known flood occurred in 1844, when a stage of about 26.6 feet on the present gage was reached.

Regulation.—The flow at this station includes the water diverted from Lake Michigan through the Chicago Drainage canal.

Accuracy.—Stage-discharge relation practically permanent; seriously affected by ice during the winters. Rating curve well-defined between 11,000 and 40,000 second-feet and fairly well defined beyond these limits. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good for open-water periods; poor for winter periods.

Cooperation.—Gage-height records furnished by the United States Engineer Corps.

Discharge measurements of Illinois River at Peoria, Ill., during the years ending Sept. 30, 1916–17.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1916.		Feet.	Sec.-ft.	1917.		Feet.	Sec.-ft.
June 27	W. G. Hoyt	17.45	30,700	Mar. 31	H. C. Beckman	15.03	20,500
Aug. 22	H. C. Beckman	11.10	11,900	July 30	do	12.67	14,700

Discharge, in second-feet, of Illinois River at Peoria, Ill., for the years ending Sept. 30, 1910–1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1910.												
1	......	......	......	......	......	......	19,600	16,200	19,600	11,300	8,460	8,040
2	......	......	......	......	......	......	19,000	17,200	19,600	11,100	8,460	8,040
3	......	......	......	......	......	......	18,400	18,400	19,600	10,900	8,320	7,900
4	......	......	......	......	......	......	17,800	19,600	19,600	10,800	8,320	7,900
5	......	......	......	......	......	......	17,200	21,100	19,600	10,600	8,320	7,900
6	......	......	......	......	......	......	17,800	22,500	19,000	10,400	8,320	8,180
7	......	......	......	......	......	......	16,900	23,700	19,000	10,300	8,040	8,320
8	......	......	......	......	......	26,900	16,400	23,700	18,700	10,000	7,900	8,600
9	......	......	......	......	......	29,000	16,200	22,900	18,400	9,860	7,770	9,020
10	......	......	......	......	......	30,300	15,800	22,900	18,100	9,860	7,770	9,020
11	......	......	......	......	......	30,800	15,600	22,900	17,500	9,720	7,770	8,880
12	......	......	......	......	......	31,200	15,800	22,100	17,200	9,580	7,770	8,880
13	......	......	......	......	......	31,200	15,000	21,400	16,600	9,440	7,770	9,160
14	......	......	......	......	......	31,200	14,600	20,800	16,200	9,300	7,770	9,160
15	......	......	......	......	......	30,300	14,200	20,200	15,800	9,300	7,510	9,020
16	......	......	......	......	......	29,800	14,200	19,900	15,600	9,300	7,640	9,020
17	......	......	......	......	......	29,400	13,800	19,000	15,000	9,300	7,770	8,880
18	......	......	......	......	......	28,500	14,200	19,000	14,600	9,160	8,040	8,880
19	......	......	......	......	......	27,700	14,200	18,700	14,400	9,160	8,040	9,020
20	......	......	......	......	......	26,900	14,000	18,400	14,200	9,160	7,770	8,880
21	......	......	......	......	......	26,500	13,800	18,100	13,800	9,160	7,770	8,880
22	......	......	......	......	......	26,100	13,800	17,500	13,400	9,160	7,770	8,880
23	......	......	......	......	......	25,300	13,800	17,800	13,000	9,300	7,770	8,880
24	......	......	......	......	......	24,500	13,800	17,800	12,700	9,160	7,770	8,740
25	......	......	......	......	......	23,700	13,800	17,800	12,300	9,160	7,640	8,880
26	......	......	......	......	......	23,300	14,200	17,800	12,100	9,160	8,040	8,740
27	......	......	......	......	......	22,100	14,200	18,400	11,900	9,160	8,040	8,880
28	......	......	......	......	......	21,700	14,200	18,400	11,600	8,880	8,040	8,880
29	......	......	......	......	......	20,800	14,600	19,000	11,600	8,880	8,040	8,880
30	......	......	......	......	......	20,200	15,400	19,300	11,400	8,600	8,040	8,880
31	......	......	......	......	......	19,900	......	19,600	......	8,600	8,040	......
1910–11.												
1	8,880	8,320	8,040			17,800	11,600	14,000	11,400	9,440	8,320	8,040
2	8,880	8,320	7,900			17,200	11,400	14,000	11,400	9,300	8,320	8,040
3	8,880	8,320	7,770			17,200	11,600	14,000	11,300	9,160	8,320	8,180
4	8,880	8,320	7,770			16,900	11,400	14,200	11,300	9,160	8,320	8,040
5	8,880	8,320	7,770	7,250		16,400	11,300	14,200	11,300	9,160	8,320	8,040
6	9,160	8,320	7,770			16,200	11,100	14,200	11,100	9,020	8,320	8,040
7	8,880	8,180	7,770		12,600	15,800	11,900	14,200	10,900	8,880	8,320	8,320
8	9,020	8,320	7,770			15,400	12,300	14,200	10,800	8,740	8,320	8,460
9	9,160	8,180	7,640			15,000	12,700	14,200	10,600	8,460	8,320	8,460
10	9,160	8,320	7,510			15,000	13,000	13,600	10,400	8,740	8,180	8,320
11	9,160	8,180	7,510			14,400	13,200	13,200	10,300	8,600	8,040	9,020
12	9,160	8,180	7,510			15,000	13,400	13,200	10,300	8,880	8,040	9,160
13	9,300	8,180	7,380			14,600	13,400	13,200	10,300	8,880	8,180	9,300
14	9,300	8,180			12,500	14,200	13,800	12,800	10,200	8,740	8,600	9,300
15	9,160	8,180		9,500	13,400	14,600	13,400	12,300	10,000	8,600	9,020	9,440
16	9,160	8,180			15,000	14,600	13,600	11,900	9,720	8,740	9,160	9,860
17	9,160	8,180			16,400	14,200	14,000	11,600	9,720	8,600	9,160	10,300
18	9,020	8,180			17,800	14,400	14,000	11,400	9,720	8,460	9,160	10,600
19	8,880	8,180			19,000	14,200	14,400	10,900	9,720	8,320	9,160	10,900
20	8,880	8,040			19,600	14,000	14,800	11,300	9,720	8,460	9,160	11,600
21	8,880	8,040			20,200	13,800	15,000	11,300	9,580	8,460	9,020	12,700
22	8,600	8,040	7,250		20,200	13,800	15,000	11,100	9,440	8,320	8,880	13,200
23	8,740	8,040			20,200	13,400	15,000	11,100	9,440	8,320	8,790	13,400
24	8,600	8,040			19,600	13,000	15,000	11,400	9,720	8,320	8,690	13,400
25	8,600	8,040			19,000	12,500	15,000	11,600	9,720	8,320	8,600	14,600
26	8,600	8,040		12,700	19,000	12,100	14,600	11,900	9,720	8,320	8,460	14,600
27	8,600	8,040			19,000	11,800	14,400	11,900	9,720	8,320	8,320	14,200
28	8,460	8,180			18,400	12,300	14,200	11,900	9,720	8,320	8,600	14,800
29	8,600	8,040			......	12,100	14,200	11,900	9,720	8,180	8,320	15,400
30	8,320	8,040			......	11,900	14,200	11,800	9,720	8,180	8,320	15,800
31	8,320	......			......	11,800	......	11,800	......	8,180	8,180	......

Daily discharge, in second-feet, of Illinois River at Peoria, Ill., for the years ending Sept. 30, 1910–1917—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1911–12.												
1	16,400	16,600	21,100				42,800	26,900	19,900	12,300	11,600	12,300
2	17,800	16,600	21,100				42,800	28,500	19,300	11,900	11,600	12,100
3	18,100	16,200	21,400				42,800	30,300	18,700	11,900	11,800	11,900
4	18,700	16,000	20,500				42,800	31,200	18,700	11,800	11,600	11,800
5	19,900	15,800	19,900	16,700			42,300	32,100	18,400	11,600	11,600	11,600
6	20,200	15,800	19,600				41,800	33,000	17,800	11,600	11,600	11,600
7	21,400	15,800	19,300				41,800	33,000	17,500	11,400	11,400	11,400
8	21,400	15,600	19,000			13,000	40,300	32,100	16,600	11,300	11,400	11,300
9	21,100	15,400	18,700				38,800	31,600	16,200	10,900	11,400	11,300
10	20,800	15,400	18,400		11,000		38,800	30,300	15,800	11,100	11,300	10,900
11	20,800	15,200	18,400				37,800	29,400	15,400	11,300	11,300	10,900
12	20,500	15,000	19,000				36,300	29,800	15,000	11,100	11,300	10,800
13	20,200	15,600	19,600				35,300	28,100	15,000	10,900	11,300	10,600
14	19,600	16,200	19,900				33,900	28,500	14,600	10,900	11,400	10,600
15	19,000	17,500	19,900	14,200			32,600	28,100	14,200	11,300	11,400	10,800
16	18,400	18,400	20,200			12,700	32,100	29,800	14,200	11,300	11,300	10,600
17	18,400	18,400	20,200			12,700	32,100	30,300	14,400	10,900	11,300	10,600
18	18,100	19,000	20,200			14,600	31,200	29,800	14,400	10,900	11,300	10,400
19	18,400	19,900	20,200			16,900	29,400	30,300	14,200	10,900	11,300	10,300
20	18,400	20,800	20,200			21,400	29,400	28,500	14,200	10,900	11,400	10,200
21	18,100	22,100	19,600			26,900	29,400	28,500	14,200	11,800	11,300	10,600
22	17,800	22,100	19,600			30,300	29,800	27,300	14,200	12,100	11,300	10,400
23	17,200	22,900	19,600			31,200	29,800	26,100	14,200	11,900	12,300	10,300
24	17,500	23,300	20,200			33,000	29,400	26,100	14,000	11,800	12,300	10,300
25	17,200	22,900	20,800	12,500	12,500	33,000	29,400	25,300	13,800	11,800	12,700	10,300
26	17,800	22,900				33,900	26,900	23,700	13,400	11,800	13,000	10,300
27	17,800	22,500				35,800	28,500	22,100	13,400	11,800	13,200	10,200
28	17,800	22,500	20,100			37,800	28,100	21,400	13,000	11,600	12,800	10,300
29	17,500	22,100				39,800	29,000	22,100	12,700	11,600	12,800	10,300
30	17,200	21,400			......	41,300	27,700	20,800	12,300	11,600	12,700	10,200
31	17,200	......			......	41,800	......	20,200	......	11,600	12,500	......
1912–13.												
1	10,000	12,300	14,000		21,200		55,000	22,900	25,700	13,600	10,200	10,000
2	10,000	12,100	13,400		20,500		55,000	21,700	25,300	13,400	10,000	10,000
3	10,000	11,900	13,400		20,200		53,900	20,800	25,300	13,200	9,860	10,000
4	10,000	11,600	13,400		19,900		52,800	19,900	24,500	12,700	10,000	10,000
5	10,000	11,800	13,400	10,100	19,600	15,900	52,300	19,600	23,300	12,700	9,860	10,000
6	9,860	12,300	13,200				51,800	18,700	22,500	12,700	9,720	9,860
7	9,860	12,700	12,800				50,800	18,100	22,900	12,300	9,860	9,720
8	9,720	12,700	13,400				49,800	17,800	22,100	12,100	9,860	9,720
9	9,860	13,000	12,700				49,800	17,800	20,800	11,900	9,720	9,720
10	10,000	13,200	12,300				49,300	17,200	20,200	11,900	9,580	9,720
11	10,000	13,400	12,800			19,000	48,800	16,600	19,600	11,800	10,000	9,720
12	10,400	13,800	12,500			21,100	50,300	16,200	19,000	11,300	10,000	9,860
13	10,600	14,600	12,300		16,700	22,500	50,800	16,000	18,400	11,300	10,000	9,720
14	10,800	14,600	11,900			23,300	50,800	16,200	17,800	11,100	10,000	9,720
15	10,800	14,600	11,900	10,300		24,900	49,800	15,800	17,200	10,900	10,200	9,720
16	10,900	14,600	11,900			26,500	48,300	15,800	16,900	10,900	10,200	9,720
17	10,900	14,800	12,100			27,300	46,800	15,800	16,600	11,300	10,400	9,720
18	11,100	15,000	12,300			26,500	44,800	16,200	16,400	11,300	10,600	9,720
19	11,300	15,000	12,300			26,500	43,300	16,200	16,000	11,300	10,900	9,720
20	11,300	14,800	12,100			26,100	40,800	15,800	15,600	11,100	10,900	9,720
21	11,300	14,800	12,100		16,200	27,700	37,800	15,800	15,400	10,900	10,800	9,720
22	11,800	14,600	11,900		16,900	27,300	35,800	16,600	15,400	10,800	10,800	9,720
23	11,900	14,600	11,800		19,000	28,100	33,400	18,400	15,200	10,600	10,900	9,720
24	11,900	15,000	11,400		19,300	29,800	32,100	19,600	15,000	10,600	10,800	9,720
25	11,900	14,600	11,300	16,600	19,300	34,800	31,200	20,500	14,600	10,600	10,600	9,580
26	11,900	14,400	11,300		19,000	39,800	29,800	20,800	14,600	10,600	10,600	9,720
27	11,900	14,400	11,300		19,000	44,800	28,500	21,400	14,600	10,400	10,600	9,720
28	11,900	14,200	11,100		18,400	48,800	27,300	22,100	14,400	10,300	10,400	9,720
29	11,600	14,000	10,900		......	51,800	25,300	24,100	14,200	10,300	10,300	9,720
30	11,900	13,800	10,900		......	55,000	24,100	25,300	13,800	10,300	10,300	9,580
31	12,100	......	10,900		......	55,000	......	25,300	......	10,200	10,300	......

Daily discharge, in second-feet, of Illinois River at Peoria, Ill., for the years ending Sept. 30, 1910–1917—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1913–14.												
1	9,720	10,000	10,300				16,900	15,400	17,200	11,400	8,880	9,160
2	9,720	9,860	10,400				17,800	15,000	16,600	11,300	8,880	9,720
3	9,580	9,860	10,600				19,300	14,600	16,200	11,300	8,880	9,440
4	9,440	10,000	10,600				19,900	14,400	16,200	11,300	8,740	9,580
5	9,440	10,000	10,800	9,860	9,650		20,800	14,400	16,400	11,000	8,600	9,440
6	9,580	10,000	10,900				21,100	14,400	15,600	10,900	8,600	9,720
7	9,580	10,000	11,300				22,900	14,000	15,400	10,900	8,600	10,000
8	9,720	10,200	11,100			10,700	22,500	14,200	15,600	10,800	8,600	10,200
9	9,720	10,300	10,900				21,700	13,800	15,400	10,600	8,320	10,000
10	9,720	10,300	10,800				21,100	14,200	15,400	10,600	8,320	10,000
11	9,720	10,000	10,900				22,100	13,800	15,400	10,300	8,740	10,200
12	9,580	9,720	10,900				22,100	14,800	15,200	10,300	8,600	10,000
13	9,580	9,860	10,900				22,500	15,000	14,800	10,200	8,600	10,000
14	9,580	10,000	10,900				22,100	16,200	14,600	10,200	8,880	10,000
15	9,720	10,000	10,800	9,240	9,450		21,700	18,400	14,400	10,000	8,880	10,300
16	9,860	10,000	10,600			13,400	21,100	19,600	14,200	10,000	8,880	10,300
17	10,200	9,720	10,600			13,400	20,800	20,800	13,800	10,000	8,600	10,300
18	10,000	9,720	10,800			14,000	19,900	21,400	13,600	10,000	8,600	10,400
19	10,000	9,720	10,600			14,200	18,700	21,700	13,400	9,860	8,600	10,300
20	10,000	9,860	10,600			14,600	19,600	22,100	13,000	9,720	8,880	10,300
21	10,000	9,580	10,800			14,600	18,100	21,400	12,700	9,580	8,880	10,000
22	10,000	9,720	10,600			14,600	18,100	21,400	12,700	9,440	8,880	10,000
23	10,000	10,000	10,600			14,600	17,800	21,100	12,500	9,300	8,740	10,200
24	10,200	10,000	10,600			14,400	17,200	20,200	12,300	9,440	9,160	10,000
25	10,200	9,860	10,800	9,340	9,250	13,600	16,400	19,600	12,500	9,440	9,160	10,200
26	10,000	10,000	10,600			14,000	16,200	19,300	12,300	9,440	9,020	10,000
27	10,300	10,000	10,400			14,800	16,200	19,000	11,900	9,300	9,160	10,000
28	10,000	10,200	10,300			14,800	15,800	18,700	11,800	9,300	9,020	10,000
29	10,000	10,200	10,300		....	15,000	15,600	17,800	11,800	9,160	9,160	9,860
30	10,000	10,200	10,300		....	15,800	15,600	17,800	11,600	9,020	9,020	9,860
31	10,000	....	10,300		....	16,200	....	17,200	....	9,020	9,160	....
1914–15.												
1	9,860	9,440	9,020			20,200	12,500	10,200	14,400	14,400	20,500	20,200
2	9,860	9,440	9,160			19,600	12,300	10,000	14,800	14,000	20,800	19,600
3	9,860	9,580	9,160			19,600	12,300	10,000	15,200	13,800	23,700	19,000
4	9,720	9,580	9,300			19,300	12,100	9,860	15,400	13,600	24,900	18,100
5	9,720	9,580	9,300	8,950	14,200	19,000	11,800	9,720	15,800	13,200	28,500	17,800
6	9,720	9,580	9,300			18,100	11,800	9,860	16,000	13,000	32,600	16,900
7	9,720	9,440	9,160			18,100	11,800	9,860	16,200	12,700	34,800	16,400
8	9,720	9,720				17,800	11,400	9,720	16,200	13,200	35,800	15,800
9	9,580	9,440				17,200	11,100	9,860	16,400	13,000	34,800	15,800
10	9,580	9,300				16,600	11,300	9,860	16,200	13,000	34,800	15,400
11	9,720	9,440				16,400	10,900	9,720	16,200	13,000	33,000	15,800
12	9,580	9,440				16,200	11,400	9,720	15,800	13,400	31,200	15,800
13	9,720	9,440				16,000	10,900	9,860	15,800	14,200	29,400	15,600
14	9,720	9,440	8,870			15,800	10,600	9,860	16,000	15,400	28,100	15,600
15	9,720	9,580		9,520		15,600	10,600	9,860	16,200	16,600	26,900	16,400
16	10,000	9,440			19,800	15,600	10,600	9,720	16,200	18,100	25,700	16,400
17	9,860	9,300				15,000	10,600	9,720	16,600	19,000	24,900	16,600
18	9,860	9,300				15,000	10,300	9,720	16,400	20,200	24,100	17,200
19	9,860	9,440				15,000	10,400	9,720	16,600	20,800	23,700	17,500
20	9,720	9,440				14,600	10,400	9,720	16,900	21,400	23,300	17,200
21	9,860	9,300				14,600	10,300	9,720	16,600	21,400	23,300	17,800
22	9,720	9,160				14,200	10,300	10,300	16,400	21,400	22,500	18,100
23	9,720	9,160			20,200	14,200	10,300	10,400	16,200	20,800	22,100	18,100
24	10,000	8,880			20,200	13,800	10,200	10,600	15,800	20,500	22,100	18,700
25	9,720	8,880	8,740	10,000	20,500	13,800	10,200	10,400	15,800	20,200	22,100	19,000
26	9,860	9,020			20,500	14,000	10,200	11,300	15,600	19,600	22,900	18,100
27	9,720	9,160			20,800	13,400	9,720	11,600	15,200	19,000	22,900	19,000
28	9,300	9,160			20,500	13,400	10,000	11,600	15,000	18,700	22,500	19,000
29	9,580	9,160			....	13,000	10,200	13,200	14,800	18,700	22,100	19,000
30	9,580	9,020			....	13,000	10,200	13,800	14,400	18,700	21,400	19,000
31	9,440	....			....	12,800	....	13,800	....	19,900	20,800	....

Daily discharge, in second-feet, of Illinois River at Peoria, Ill., during the years ending Sept. 30, 1910-1917—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915–16.												
1	19,300	12,700	12,100			22,100	32,600	17,800	20,200	28,100	13,400	10,600
2	19,000	12,500	12,300			22,100	33,900	17,200	20,800	26,900	13,000	10,600
3	19,000	12,500	12,300			21,100	34,800	16,900	21,100	26,500	12,700	10,300
4	18,700	12,100	12,700			20,200	35,300	16,600	21,100	25,700	12,300	10,200
5	18,700	12,100	12,700	14,200	34,400	19,900	35,300	16,600	21,100	24,500	12,300	10,000
6	18,400	12,100	12,700			19,300	35,300	16,200	21,400	23,700	12,100	10,300
7	18,100	11,900	12,300			18,700	34,400	16,200	20,800	22,900	11,900	10,300
8	17,800	11,800	12,500			19,000	34,400	16,200	20,200	22,100	12,100	10,400
9	17,500	11,800	12,700			17,800	32,100	15,800	21,400	21,400	11,900	10,300
10	16,900	11,400	12,700			18,400	30,800	15,400	22,900	20,800	11,600	10,300
11	16,000	10,400	13,000			17,800	28,500	15,400	25,300	19,900	13,000	10,300
12	16,200	11,300	12,700			17,500	28,500	15,600	26,500	19,300	13,400	10,300
13	16,000	11,400	12,700			17,200	27,700	15,800	27,700	18,700	13,400	10,300
14	16,000	11,400	12,500			17,200	26,900	15,800	27,700	18,100	12,800	10,300
15	15,800	11,300	12,300	18,800	28,200	16,900	26,100	15,800	28,500	17,500	12,700	10,400
16	15,400	10,900	12,300			16,200	24,500	16,200	28,100	17,200	12,700	10,300
17	15,200	11,300	11,900			15,800	24,100	17,200	28,500	16,600	12,500	10,600
18	15,000	11,100	11,900			15,800	23,300	18,700	28,500	16,400	12,300	10,400
19	14,800	11,100	11,900			15,800	22,100	19,600	28,500	16,000	12,300	10,300
20	14,800	10,900	11,900			15,200	21,400	20,800	27,700	15,800	12,100	10,200
21	14,600	11,300	11,600			15,400	20,800	21,400	28,500	15,800	11,900	10,200
22	14,400	11,300	11,300			16,000	20,800	21,400	28,500	15,400	11,800	10,200
23	14,000	11,300	11,300			15,200	20,800	21,700	29,400	15,200	11,600	10,200
24	14,000	11,300	11,400			15,000	19,900	22,100	30,300	15,000	11,300	10,200
25	13,600	11,300	11,600		24,600	15,000	19,600	21,400	30,300	14,800	11,300	10,000
26	13,400	11,800		37,000		16,200	19,600	21,100	30,300	14,600	11,300	10,000
27	13,200	11,800				18,100	19,300	21,400	30,300	14,200	11,300	9,860
28	13,200	11,900	11,200			19,900	18,400	21,100	29,800	14,200	10,900	10,200
29	13,200	12,300				23,700	17,800	20,800	29,000	13,800	10,800	10,200
30	13,000	12,100			....	27,700	17,500	20,800	28,500	13,600	10,600	10,200
31	12,500	....			....	30,300	....	20,500	....	13,400	10,600	....
1916–17.												
1	10,000	11,400	12,300				21,700	17,800	14,400	20,200	14,600	11,600
2	10,000	11,600	12,300				21,100	17,500	14,200	20,200	14,600	11,900
3	10,000	11,600	12,300			12,300	19,900	17,500	14,600	19,600	14,200	11,600
4	10,000	11,600	12,300				20,200	17,500	14,600	19,300	14,200	11,600
5	10,200	11,600	12,300		12,100		21,100	17,800	15,400	18,700	13,800	11,600
6	10,300	11,600	12,300			12,500	20,200	17,500	16,400	18,100	13,600	11,600
7	10,000	11,400	11,900			12,100	20,500	17,200	16,600	17,800	13,400	12,100
8	10,000	11,300	12,700			12,300	21,700	16,600	18,700	17,200	13,400	12,300
9	10,400	11,900	12,300			12,700	21,100	16,600	20,800	16,900	13,400	12,300
10	10,000	11,600	12,700			12,500	20,500	16,600	22,900	16,600	13,400	12,100
11	10,000	12,100				12,700	20,800	16,400	24,500	15,800	13,000	11,900
12	10,000	11,900				13,000	21,100	16,200	26,900	16,000	13,000	11,900
13	10,000	11,900				13,400	21,700	16,000	30,300	16,000	12,800	11,800
14	10,000	11,900				14,800	20,200	15,800	33,000	15,800	12,800	11,600
15	10,000	11,900	12,600	12,500	11,700	16,600	20,200	15,600	34,800	15,600	12,700	11,900
16	10,000	11,400				19,000	19,600	15,200	34,800	15,400	12,700	11,900
17	10,000	11,900				20,200	19,000	14,800	34,800	15,400	12,700	11,800
18	10,000	11,900				22,100	19,000	14,600	33,400	15,200	12,300	11,900
19	10,200	11,800				22,500	19,000	14,000	33,000	15,000	12,100	11,600
20	10,000	11,900				23,300	18,400	14,600	32,100	15,000	11,900	11,600
21	10,400	11,900				23,300	18,400	14,200	30,300	15,000	11,900	11,600
22	10,400	11,900				22,900	18,700	14,600	29,400	14,800	12,300	11,600
23	10,600	11,900				22,500	19,000	13,800	27,700	14,800	11,900	11,600
24	10,900	11,900				22,900	19,000	13,800	26,900	14,800	11,900	11,300
25	10,800	11,900			12,000	21,700	18,400	13,800	25,300	14,800	11,900	11,100
26	11,100	11,400	12,500			22,900	18,100	13,800	24,100	15,000	11,600	11,100
27	11,300	11,600				22,900	18,100	13,800	23,700	15,000	11,300	11,300
28	11,300	12,100				22,100	18,100	14,200	22,500	15,000	11,800	11,100
29	11,400	12,300			....	22,100	17,500	13,800	22,100	14,800	11,800	11,100
30	11,600	12,300			....	22,100	17,200	13,800	20,800	14,800	11,600	11,300
31	11,400	....			....	21,100	....	14,000	....	14,800	11,600	....

NOTE.—Discharge for periods when river was frozen over, estimated from gage heights, weather records, and flow at other stations; braced figures show the mean discharge for periods indicated.

Monthly discharge of Illinois River at Peoria, Ill., for the years ending Sept. 30, 1910–1917.

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
1910.			
March	31,200	19,900	20,600
April	19,600	13,800	15,400
May	23,700	16,200	19,700
June	19,600	11,400	15,700
July	11,300	8,600	9,610
August	8,460	7,510	7,950
September	9,160	7,900	8,710
1910–11.			
October	9,300	8,320	8,880
November	8,320	8,040	8,170
December	8,040	....	7,440
January	....	....	9,910
February	20,200	....	15,500
March	17,800	11,800	14,400
April	15,000	11,100	13,400
May	14,200	10,900	12,600
June	11,400	9,440	10,200
July	9,440	8,180	8,630
August	9,160	8,040	8,550
September	15,800	8,040	10,800
The year	20,200	....	10,700
1911–12.			
October	21,400	16,400	18,700
November	23,300	15,000	18,700
December	....	....	19,900
January	....	....	14,400
February	....	....	11,500
March	41,800	....	14,900
April	42,800	26,900	34,400
May	33,000	20,200	27,900
June	19,900	12,300	15,300
July	12,300	10,900	11,500
August	13,200	11,300	11,800
September	12,300	10,200	10,800
The year	42,800	10,200	17,500
1912–13.			
October	12,100	9,720	10,900
November	15,000	11,000	13,800
December	14,000	10,900	12,200
January	....	....	12,500
February	21,100	....	17,800
March	55,000	....	27,300
April	55,000	24,100	43,300
May	25,300	15,800	18,900
June	25,700	13,800	18,400
July	13,600	10,200	11,400
August	10,900	9,580	10,300
September	10,000	9,580	9,770
The year	55,000	....	17,200
1913–14.			
October	10,300	9,440	9,840
November	10,300	9,580	9,960
December	11,300	10,300	10,700
January	....	....	9,480
February	....	....	9,460
March	16,200	....	12,700
April	22,900	15,600	19,400
May	22,100	13,800	17,500
June	17,200	11,600	14,200
July	11,400	9,020	10,100
August	9,160	8,320	8,810
September	10,400	9,160	9,980
The year	22,900	8,320	11,800

Monthly discharge of Illinois River at Peoria, Ill., for the years ending Sept. 30, 1910–1917—Continued.

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
1914–15.			
October	10,000	9,300	9,730
November	9,720	8,880	9,340
December	9,300	....	8,900
January	....	....	9,510
February	....	....	17,900
March	20,200	12,800	15,800
April	12,500	9,720	10,900
May	13,800	9,720	10,400
June	16,900	14,400	15,800
July	21,400	12,700	16,900
August	35,800	20,500	26,000
September	20,200	15,400	17,500
The year	35,800	....	14,000
1915–16.			
October	19,300	12,500	15,700
November	12,700	10,400	11,600
December	13,000	....	12,000
January	....	....	23,800
February	....	....	29,200
March	30,300	15,000	18,600
April	35,300	17,500	26,200
May	22,100	15,400	18,400
June	30,300	20,200	26,100
July	28,100	13,400	18,600
August	13,400	10,600	12,100
September	10,600	9,860	10,300
The year	35,300	9,860	18,500
1916–17.			
October	11,600	10,000	10,400
November	12,300	11,300	11,800
December	....	....	12,500
January	....	....	12,500
February	....	....	11,900
March	23,300	....	17,700
April	21,700	17,200	19,600
May	17,800	13,800	15,500
June	34,800	14,200	21,600
July	20,200	14,800	16,200
August	14,600	11,300	12,700
September	12,300	11,100	11,700
The year	34,800	10,000	14,800

KANKAKEE RIVER AT MOMENCE, ILL.

Location.—In sec. 24, T. 31, N., R. 13 E., at highway bridge in Momence, Kankakee County, half a mile below Chicago & Eastern Illinois Railroad bridge and 1½ miles above Tower Creek.

Drainage area.—2,340 square miles.

Records available.—February 22, 1905, to July 20, 1906; December 3, 1914, to September 30, 1917.

Gage.—Chain gage attached to bridge over left channel; read by Oscar Conrad.

Discharge measurements.—Made from upstream side of bridge across the two channels during medium and high stages, and by wading during low stages.

Channel and control.—Coarse gravel; practically permanent; river at gage divided into two channels by an island. Aquatic plants sometimes grow in bed of river during summer. Recent measurements show that there has been a change in the stage-discharge relation as expressed by the rating curve used prior to July 20, 1906.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.5 feet at 5 p. m., January 14 (discharge not determined because of backwater from ice); maximum open-water stage recorded, 3.5 feet April 6 and 7 (discharge, 4,372 second-feet); minimum stage, 1.67 feet September 29 and 30 (discharge, 534 second-feet).

1905–6 and 1915–17: Maximum stage recorded, 7.5 feet January 21, 1916 (discharge not determined because of backwater from ice); maximum open-water stage, 6.4 feet January 22, 1916 (discharge, estimated from extension of rating curve, 12,600 second-feet). Minimum discharge, 360 second-feet, July 13–20, 1906.

ACCURACY.—Stage-discharge relation permanent; seriously affected by ice during winter. Rating curve well defined below and fairly well defined above 3,100 second-feet. Gage read to hundredths twice daily until April 30 and once daily afterwards. Daily discharge ascertained by applying daily gage heights to rating table. Open-water records good; winter records roughly approximate.

Discharge measurements of Kankakee River at Momence, Ill., during the year ending Sept. 30, 1917.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 21	2.15	1,180
Aug. 11	1.83	761

Daily discharge, in second-feet, of Kankakee River at Momence, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	960	1,720	1,720				3,600	2,980	2,160	990	1,070	609
2	960	1,720	1,830				3,350	2,860	2,160	990	990	583
3	975	1,720	1,830				3,350	2,500	2,280	915	990	570
4	975	1,720	1,940				3,350	2,160	2,280	915	945	570
5	945	1,720	2,160	1,240	770	1,270	3,350	1,940	2,280	960	900	570
6	900	1,720	2,160				4,370	1,720	2,280	1,070	728	570
7	840	1,720	2,280				4,370	1,720	2,390	1,150	714	546
8	870	1,620	2,280				4,110	1,620	2,390	1,150	714	674
9	930	1,620	2,500			1,620	4,110	1,520	2,280	1,150	687	635
10	930	1,620	2,500			1,520	4,110	1,520	2,280	1,150	674	609
11	945	1,620	2,620			1,420	3,850	1,520	2,280	1,150	661	596
12	930	1,520	2,620			1,420	3,850	1,420	2,160	1,240	648	583
13	930	1,520	2,620			1,520	3,850	1,420	1,940	1,330	622	583
14	900	1,520	2,620			2,500	3,850	1,420	1,720	1,330	622	583
15	870	1,240		1,150	570	2,980	3,850	1,330	1,620	1,330	622	583
16	870	1,240				2,390	3,600	1,330	1,520	1,420	622	570
17	900	1,240				2,390	3,600	1,330	1,420	1,420	609	558
18	945	1,150				2,390	3,600	1,330	1,420	1,420	609	558
19	990	1,150				2,390	3,350	1,330	1,420	1,420	596	558
20	1,520	1,150				2,390	3,350	1,520	1,420	1,330	596	558
21	1,420	1,150				2,390	3,350	1,620	1,330	1,330	583	546
22	1,420	1,150	1,550			2,620	3,100	1,520	1,240	1,330	583	546
23	1,420	1,330				3,350	2,980	1,520	1,240	1,520	622	558
24	1,420	1,420				3,100	2,740	1,520	1,150	2,160	635	546
25	1,520	1,520			790	2,860	2,620	1,420	1,150	1,720	622	546
26	1,520	1,520		920		2,860	2,620	1,420	1,150	1,330	609	546
27	1,620	1,520				2,740	2,390	1,830	1,150	1,240	609	546
28	1,620	1,520				2,500	2,160	1,720	1,070	1,150	756	546
29	1,620	1,620			......	2,500	3,350	1,720	1,070	1,150	687	534
30	1,620	1,720			......	2,500	3,100	1,830	1,070	1,070	609	534
31	1,720	......			......	2,500	......	1,940	......	1,070	609	......

NOTE.—Discharge Dec. 15 to Mar. 8 estimated, because of ice, from gage heights, observer's notes, and weather records. Braced figures show mean discharge for periods indicated.

Monthly discharge of Kankakee River at Momence, Ill., for the year ending Sept. 30, 1917.

[Drainage area, 2,340 square miles.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,720	840	1,160	0.496	0.57
November	1,720	1,150	1,490	.637	.71
December	2,620		1,870	.799	.92
January			1,100	.470	.54
February			704	.301	.31
March	3,350		2,100	.897	1.03
April	4,370	2,160	3,440	1.47	1.64
May	2,980	1,330	1,700	.726	.84
June	2,390	1,070	1,710	.731	.82
July	2,160	915	1,230	.538	.62
August	1,070	583	695	.297	.34
September	674	534	570	.244	.27
The year	4,370	534	1,480	.632	8.61

KANKAKEE RIVER AT CUSTER PARK, ILL.

Location.—In sec. 19, T. 32 N., R. 10 E., at Wabash Railroad bridge in Custer Park, Will County, about half a mile above Horse Creek and 15 miles below dam and power plant at Kankakee.

Drainage area.—4,870 square miles.

Records available.—November 6, 1914, to September 30, 1917.

Gage.—Chain gage attached to bridge; read by J. H. Swords.

Discharge measurements.—Made from downstream side of bridge.

Channel and control.—Solid rock strewn with boulders and gravel; right half of channel deep, with fissures in bed; left half shallow. May shift slightly.

Extremes of discharge.—Maximum stage recorded during year, 10.8 feet June 9 and 10 (discharge, 15,000 second-feet); minimum stage, 5.0 feet at 5 p. m. September 18 and 19 (discharge, 470 second-feet).

1915–1917: Maximum stage recorded, 12.6 feet July 11, 1915 (discharge, 21,300 second-feet); minimum stage, 4.09 feet November 15, 1914 (discharge not determined); mean discharge for the day estimated 250 second-feet.

Regulation.—Operation of power plant at Kankakee causes slight fluctuation at gage.

Accuracy.—Stage-discharge relation changed slightly during year; seriously affected by ice during winter. Rating curve used to March 12 well defined above 1,820 second-feet and fairly well defined between 1,130 and 1,820 second-feet; extended below 1,130 second-feet; curve used after March 12 well defined above and fairly well defined below 1,820 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good for medium and high stages and fair for low stages during open-water periods; winter records poor.

The following discharge measurement was made by H. C. Beckman:
August 10, 1917: Gage height, 6.03 feet; discharge, 1,840 second-feet.

Daily discharge, in second-feet, of Kankakee River at Custer Park, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug	Sept.
1	955	1,670	1,670				3,680	2,880	3,270	2,150	1,440	1,510
2	1,010	1,670	1,670				5,640	2,880	4,390	1,980	1,140	1,280
3	1,070	1,670	1,670				6,720	2,880	4,630	1,740	1,280	1,140
4	1,070	1,520	1,740				7,290	2,690	4,150	1,580	1,140	1,000
5	1,130	1,520	1,820	1,670	1,140		7,880	2,600	3,470	1,440	1,000	875
6	1,130	1,520	2,060			1,540	9,720	2,410	5,640	1,360	1,000	940
7	1,130	1,380	2,060				9,720	2,410	12,300	1,440	1,280	940
8	1,130	1,380	2,240				9,720	2,320	14,300	1,820	1,980	1,070
9	1,130	1,380	2,460				8,480	2,320	15,000	2,150	2,150	1,440
10	900	1,320	2,690				7,290	2,230	15,000	2,410	1,740	1,900
11	1,010	1,450					6,440	2,230	13,300	2,060	1,580	1,740
12	1,070	......					5,900	2,060	11,600	1,740	1,360	1,510
13	1,010	......				2,500	5,130	1,820	10,700	1,580	1,210	1,280
14	1,010	......				5,900	5,130	1,820	9,100	1,440	1,070	1,000
15	1,010	......	2,190	1,520	770	7,000	4,630	1,740	7,000	1,360	1,000	1,000
16	955	......				7,290	4,630	1,740	5,640	1,440	940	810
17	900	......				7,290	4,390	1,600	4,630	1,580	875	875
18	1,010	......				6,170	4,390	1,520	3,910	2,320	875	588
19	1,010	......				5,640	4,390	1,520	3,270	2,320	745	611
20	1,010	......				5,130	4,630	1,520	3,070	2,230	940	745
21	1,380	......				4,390	4,390	1,450	2,600	2,060	745	1,000
22	1,520	......				4,390	4,390	1,600	2,320	1,820	875	706
23	1,520	......				4,150	3,910	1,600	2,150	2,410	706	719
24	1,520	......				5,130	3,470	1,980	2,060	2,690	940	732
25	1,600	......	1,670	1,250	900	4,880	3,270	2,320	1,980	2,230	940	745
26	1,670	......				5,380	3,270	2,500	2,060	2,150	940	680
27	1,670	......				4,630	3,470	2,500	1,980	2,150	940	706
28	1,600	......				4,150	3,270	2,690	1,900	2,150	875	622
29	1,600	......			......	3,680	2,880	2,320	1,980	1,820	940	680
30	1,670	......			......	3,470	2,880	2,150	1,980	1,820	1,280	611
31	1,670	......			......	3,270	......	2,600	......	1,660	1,660	......

NOTE.—Discharge Dec. 11 to Mar. 12 estimated, because of ice, from gage heights, observer's notes, and weather records. Braced figures show mean discharge for periods indicated.

Monthly discharge of Kankakee River at Custer Park, Ill., for the year ending Sept. 30, 1917.

[Drainage area, 4,870 square miles]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,670	900	1,230	0.253	0.29
December	....	....	1,950	.400	.46
January	....	....	1,470	.302	.35
February	....	....	939	.193	.20
March	7,290	....	3,640	.747	.86
April	9,720	2,880	5,370	1.10	1.23
May	2,880	1,450	2,160	.444	.51
June	15,000	1,900	5,850	1.20	1.34
July	2,690	1,360	1,910	.392	.45
August	2,150	706	1,150	.236	.27
September	1,900	588	948	.195	.22

DES PLAINES RIVER AT LEMONT, ILL.

LOCATION.—In sec. 20, T. 37 N., R. 11 E., at concrete highway bridge at Stephens Street, about a quarter of a mile north of main section of Lemont, Cook County; 8 miles above junction of Des Plaines River and Chicago Drainage Canal.

DRAINAGE AREA.—705 square miles.

RECORDS AVAILABLE.—November 4, 1914, to September 30, 1917.

GAGE.—Enamel staff gage attached to bridge; read by William Weck, jr.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading below dam.

CHANNEL AND CONTROL.—A concrete dam forming a new control and changing the former stage-discharge relation was built across the channel about 500 feet below the gage August 20, 1916; permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.6 feet at 8 a.m. March 19 (discharge, 2,960 second-feet); minimum stage, 2.48 feet October 8, 10, 11, and 16, and September 5 (discharge, 9 second-feet).

1915–1917: Maximum stage recorded, 6.1 feet January 23, 1916 (discharge not determined because of backwater from ice); maximum open-water stage recorded, 5.9 feet June 10, 1916 (discharge, 3,380 second-feet); minimum discharge, 3.9 second-feet (measured by current meter) November 26, 1914.

ACCURACY.—Stage-discharge relation permanent; affected by ice during a short period in February. Rating curve well defined between 120 and 2,220 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good except those for very low stages, which are fair.

Discharge measurements of Des Plaines River at Lemont, Ill., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Dec. 9	H. C. Beckman	3.14	346
Mar. 15	G. J. Trinkaus	4.20	1,309
July 11	H. C. Beckman	2.86	155

Daily discharge, in second-feet, of Des Plaines River at Lemont, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	19	212	315	232	245	85	492	400	400	500	180	22
2	17	186	287	120	232	78	508	670	476	524	150	28
3	44	168	252	120	212	70	540	900	445	476	132	23
4	31	100	219	138	200	52	532	805	385	350	100	10
5	19	115	212	180	180	59	508	760	329	315	80	9
6	10	115	273	266	168	66	625	715	445	245	70	28
7	24	115	238	371	156	80	715	625	670	232	66	24
8	9	120	329	400	144	95	670	524	805	206	90	22
9	19	168	378	422	132	120	540	422	625	180	70	22
10	9	259	445	385	115	144	476	315	524	180	66	22
11	9	357	430	385	95	245	385	245	445	156	52	22
12	15	329	422	371	82	371	378	212	415	144	44	22
13	28	273	385	371	70	715	329	212	400	95	33	22
14	21	232	232	315	66	1,050	287	180	476	150	33	22
15	10	238	287	301	63	1,250	280	168	760	180	33	22
16	9	168	357	245	58	1,460	215	138	805	329	31	28
17	33	168	245	226	52	1,630	219	120	625	430	33	22
18	19	156	245	212	61	2,400	238	120	524	871	33	17
19	43	150	232	200	70	2,830	245	120	415	329	28	17
20	24	168	212	200	78	1,200	301	110	329	280	33	28
21	100	156	193	200	87	1,050	400	110	315	259	28	33
22	180	132	162	232	95	1,050	245	120	238	219	24	23
23	378	168	132	315	82	1,100	350	315	212	540	10	10
24	301	206	156	212	70	1,460	430	670	150	900	15	10
25	315	430	132	168	82	1,520	350	625	193	806	22	10
26	287	378	156	132	95	1,350	259	492	245	582	28	23
27	273	371	156	95	92	1,150	308	385	245	430	10	31
28	301	357	180	150	88	1,000	287	350	273	329	22	28
29	287	343	212	168	......	805	301	329	430	259	22	28
30	233	315	232	200	......	670	308	315	476	245	22	10
31	219	......	200	258	......	540	......	329	......	212	10	......

NOTE.—Discharge interpolated for Dec. 22 and every alternate day from Feb. 11 to Mar. 10; estimated Feb. 1-10, because of ice, from gage heights, observer's notes, and weather records.

Monthly discharge of Des Plaines River at Lemont, Ill., for the year ending Sept. 30, 1917,

[Drainage area, 706 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	378	9	106	0.150	0.17
November	430	100	224	.318	.35
December	445	132	255	.362	.42
January	400	96	218	.352	.41
February	245	52	113	.160	.17
March	2,830	52	831	1.18	1.36
April	715	219	392	.556	.62
May	900	110	381	.540	.62
June	805	150	436	.618	.69
July	900	95	337	.478	.55
August	180	10	50.6	.072	.08
September	33	9	21.2	.030	.03
The year	2,830	9	284	.403	5.47

DES PLAINES RIVER AT JOLIET, ILL.

Location.—In NE. ¼ sec. 9, T. 35 N., R. 10 E., at Jackson Street Bridge, Joliet, Will County, about 1,200 feet upstream from Cass Street Bridge.

Drainage area.—Not measured.

Records available.—December 3, 1914, to September 30, 1917; on original chain gage September 5 to December 19, 1914.

Gage.—Gurley seven-day water-stage recorder, installed December 3, 1914. Chain gage attached to upstream side of bridge at Cass Street read from September 5 to December 19, 1914.

Discharge measurements.—Made from upstream side of Cass Street Bridge.

Channel and control.—Channel excavated in solid rock, with a concrete wall on either side; probably permanent.

Extremes of discharge.—Maximum mean daily discharge during days of record for the year, 10,600 second-feet July 24; minimum daily discharge, 6,340 second-feet January 1.

1914–1917: Maximum daily discharge during days of record, 13,200 second-feet June 10, 1916; minimum daily discharge, 5,420 second-feet, April 25, 1915.

Diversions.—Water is diverted to the Illinois & Michigan Canal at dam No. 1, about 100 feet above the gage.

Regulation.—Flow past the gage is largely regulated by the operation of the power plant of the sanitary district of Chicago at Lockport, which utilizes the flow of the Chicago Drainage Canal and, to a lesser extent, by the operation of the Economy Light & Power Co.'s plant, about 100 feet above gage.

Accuracy.—Stage-discharge relation permanent; not affected by ice. Rating curve well defined. Operation of the water-stage recorder satisfactory except for periods indicated in footnote to daily-discharge table. Daily discharge ascertained by use of discharge integrator. Records excellent.

Discharge measurements of Des Plaines River at Joliet, Ill., during the year ending Sept. 30, 1917.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
July 12	6.75	[a] 13,700
12	3.65	6,210

[a] The flow in the Illinois & Michigan Canal, diverting water around the gage, was 506 second-feet, as measured by current meter.

Daily discharge, in second feet of Des Plaines River at Joliet, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	8,340	7,760	8,360	6,340	8,820	7,960	8,150	7,970	8,470	9,890	9,400	(a)
2	7,590	7,880	8,360	8,050	9,080	8,200	8,120	8,170	8,060	9,430	9,180	(a)
3	7,590	8,130	7,760	8,100	8,000	7,870	8,110	8,340	8,520	9,780	b9,220	(a)
4	7,340	7,560	8,480	8,300	b6,920	7,660	8,460	8,970	8,470	9,800	9,200	(a)
5	7,050	8,020	8,540	8,110	8,000	7,930	8,800	9,120	8,520	9,600	9,200	(a)
6	7,130	8,310	8,360	8,130	8,100	7,940	8,760	8,690	9,400	9,560	9,300	8,940
7	6,670	7,400	7,950	7,100	8,130	8,470	8,370	8,480	8,500	9,280	9,290	9,240
8	6,770	7,860	8,390	8,780	8,150	8,310	8,500	8,580	9,070	9,710	9,000	9,720
9	7,230	7,920	(a)	8,660	8,340	8,040	8,190	8,260	9,100	9,420	9,010	9,200
10	7,250	8,170	(a)	8,670	b7,730	7,620	8,480	8,460	9,170	9,410	9,140	9,260
11	7,110	7,850	(a)	8,520	7,170	8,050	8,240	8,140	8,920	9,600	9,140	9,020
12	7,180	8,730	(a)	8,840	8,090	8,250	7,990	8,130	8,510	b9,700	9,520	8,900
13	7,740	8,970	(a)	b7,960	7,960	8,390	8,010	7,990	9,740	9,580	9,300	8,900
14	7,750	8,730	(a)	7,500	8,020	10,000	7,950	7,780	9,640	8,740	9,310	9,080
15	6,650	8,980	(a)	8,500	8,180	9,130	7,660	7,770	9,700	9,600	9,040	8,740
16	7,610	8,720	(a)	8,500	8,320	9,690	7,700	7,680	9,710	9,360	9,120	8,860
17	7,620	8,380	(a)	8,520	8,090	9,450	7,590	7,720	9,610	9,950	9,200	8,340
18	7,660	8,020	(a)	8,310	7,980	9,410	7,540	8,150	9,900	9,760	8,940	8,800
19	7,860	7,020	(a)	8,240	8,460	9,990	7,640	7,220	9,580	9,660	9,840	8,370
20	7,860	8,530	8,420	8,170	8,100	9,280	7,560	b7,980	9,420	9,920	9,220	8,420
21	b7,870	8,380	8,590	7,930	8,150	8,920	7,500		9,490	b9,630	9,400	8,850
22	7,530	8,540	8,640	8,220	7,710	8,560	7,980		9,540	9,670	9,260	7,940
23	8,060	8,500	7,830	8,630	7,760	8,540	8,190	8,500	9,380	10,100	9,140	8,660
24	8,260	8,600	7,060	8,110	8,000	(a)	8,220		9,470	10,600	9,120	8,950
25	8,190	8,440	b7,650	8,360	7,820	(a)	8,100		9,280	10,200	9,160	8,860
26	7,850	7,370	8,330	8,340	7,660	(a)	8,020	b8,860	9,260	9,930	9,260	8,810
27	7,910	8,590	7,890	7,520	8,130	(a)	8,040	8,920	9,320	10,100	8,960	9,410
28	7,620	8,710	8,170	6,980	8,390	(a)	8,320	8,700	9,540	b9,430	b9,200	(a)
29	7,360	8,380	8,470	8,430	....	(a)	8,540	8,220	9,750	9,720	9,200	b9,020
30	8,100	7,230	7,800	8,520	....	(a)	7,910	8,170	8,930	9,320	9,100	8,340
31	8,100	....	6,650	8,660	....	(a)	....	8,340	....	9,300	9,100	....

a No record.
b Discharge partly estimated because of incomplete gage record.

NOTE.—Daily discharge in the above table does not include the flow in the Illinois & Michigan Canal (see "Diversions" in the station description). No gage height record Oct. 20, Jan. 14-16, Feb. 5, 6, May 21-25, Aug. 4-6 and 29-31; discharge estimated.

Monthly discharge in second-feet, of Des Plaines River at Joliet, Ill., for the year ending Sept. 30, 1917.

Month.	Maximum.	Minimum.	Mean.
October	8,340	6,650	7,560
November	8,980	7,020	8,190
January	8,840	6,340	8,160
February	9,080	6,920	8,040
March 1-23	10,000	7,620	8,590
April	8,800	7,500	8,090
June	9,900	8,060	9,200
July	10,600	8,740	9,670
August	9,840	8,940	9,210

NOTE.—Discharge in the above table does not include flow of the Illinois & Michigan Canal, which diverts water around the gage. See "Diversions" in station description and measurement of flow in the canal made July 12.

FOX RIVER AT ALGONQUIN, ILL.

Location.—In NW. ¼ sec. 34, T. 43 N., R. 8 E. third principal meridian, at Chicago Street Bridge in Algonquin, McHenry County, about 100 feet above Public Service Co.'s dam and 500 feet above Crystal Lake outlet.

Records available.—October 1, 1915, to September 30, 1917.

Drainage area.—1,340 square miles (measured on map issued by U. S. Geological Survey; scale, 1 to 500,000).

Gage.—Enamel staff gage attached to concrete abutment of bridge; read by Edward Pedersen.

Channel and control.—Control is a concrete dam about 100 feet below gage; appears to be cracking and may settle.

Discharge measurements.—Made from upstream side of bridge or by wading below dam.

Extremes of discharge.—Maximum stage recorded during year, 2.8 feet at 7 a. m. and 6 p. m. March 28 (discharge, 2,260 second-feet); minimum stage, 1.10 feet September 7 and 8 (discharge, 279 second-feet).

1916–17: Maximum stage recorded, 5.3 feet at 6 p. m., March 31, 1916 (discharge, 7,120 second-feet); minimum stage, 0.98 foot August 7 and 8, 1916 (discharge, 209 second-feet).

Diversions.—Water is diverted to operate grist mill at dam, which is run on average of about 4 hours a day, except Sundays, from September to March, inclusive, and one day a week during rest of year. If total used for each day were uniformly distributed it would probably average less than 5 second-feet and never exceed 8 second-feet.

Accuracy.—Stage-discharge relation permanent; not affected by ice. Rating curve fairly well defined. Gage read to hundredths twice daily As storage pond is large the small amount of water used by grist mill does not noticeably affect the gage heights. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Fox River at Algonquin, Ill., during the years ending Sept. 30, 1916–1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1915–16.		*Feet.*	*Sec.-ft.*	1915–16.		*Feet.*	*Sec.-ft.*
Oct. 2[a]	William Kessler	2.82	2,730	Sept. 8	H. C. Beckman	1.22	368
2	....do	2.84	[b] 2,350	8	....do	1.22	353
12	....do	2.29	[b] 1,420				
16	....do	2.18	[b] 1,340	1916–17.			
27	....do	1.88	[b] 979	Feb. 21[a]	....do	1.20	380
Nov. 22[a]	....do	1.46	639	Aug. 28	....do	1.17	330
29	....do	1.88	[b] 963	28	....do	1.17	331

[a] Measurement made at C. & N. W. Ry. bridge 1.000 feet below gage; poor measuring section.

[b] Discharge supercedes that published in Water-Supply Paper No. 435. Vertical-velocity curves obtained in 1915 and 1918 indicate that a coefficient of 0.97 should have been applied to the mean of the velocities at 0.2 and 0.8 of the depth in order to obtain mean velocity. The coefficient had not been applied to discharge previously published for this measurement.

Daily discharge, in second-feet, of Fox River at Algonquin, Ill., for the years ending Sept. 30, 1916 and 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915-16.												
1	2,260	759	1,020	500	2,940	1,330	5,860	1,540	664	860	232	305
2	2,260	712	1,080	535	2,600	1,330	5,450	1,470	664	810	232	305
3	2,430	712	1,080	567	2,600	1,200	5,250	1,400	664	759	220	305
4	2,260	664	1,080	620	2,430	1,080	5,050	1,400	620	712	220	305
5	2,180	664	1,020	664	2,430	1,020	4,650	1,400	620	712	215	310
6	2,090	664	967	759	2,260	1,020	4,450	1,400	664	664	215	331
7	2,000	620	914	759	2,260	914	4,050	1,400	967	620	209	344
8	1,920	575	860	759	2,180	810	3,860	1,400	1,400	575	215	358
9	1,840	575	860	759	2,090	759	3,480	1,330	2,000	509	244	358
10	1,610	558	810	759	2,000	712	3,120	1,260	2,180	469	292	358
11	1,540	524	810	759	2,000	712	2,600	1,260	2,180	438	324	358
12	1,470	492	759	759	1,920	759	2,430	1,140	2,260	408	331	372
13	1,400	492	759	759	1,840	759	2,260	1,140	2,260	380	331	372
14	1,400	492	759	712	1,760	810	2,180	1,080	2,260	344	331	372
15	1,330	492	712	712	1,610	860	2,000	1,020	2,260	310	331	372
16	1,260	509	712	664	1,470	914	1,920	967	2,180	296	331	372
17	1,260	524	664	620	1,260	914	1,760	914	2,180	279	331	422
18	1,260	518	620	620	1,200	967	1,610	860	2,090	279	324	454
19	1,330	518	575	575	1,140	967	1,540	860	2,000	279	318	461
20	1,260	567	575	575	1,140	967	1,540	860	1,920	279	318	461
21	1,260	558	575	712	1,140	914	1,540	860	1,840	279	318	461
22	1,200	518	518	860	1,200	1,080	1,540	860	1,760	267	318	476
23	1,140	518	518	1,200	1,400	967	1,610	810	1,610	261	318	492
24	1,080	518	524	1,610	1,470	1,020	1,610	759	1,470	255	318	500
25	1,020	575	509	2,260	1,540	1,330	1,680	712	1,400	255	318	500
26	967	664	509	2,600	1,610	1,840	1,680	664	1,330	255	310	509
27	967	712	509	3,120	1,610	3,120	1,760	664	1,200	250	310	509
28	914	810	500	3,480	1,540	4,050	1,680	664	1,140	244	305	516
29	914	967	492	3,480	1,400	4,650	1,610	664	1,080	244	305	524
30	860	1,020	477	3,300	....	5,050	1,540	759	1,020	238	305	524
31	810	....	477	3,120	....	6,070	....	712	....	238	305	....
1916-17.												
1	542	967	914	415	365	351	2,090	1,330	860	860	664	305
2	558	967	967	423	365	354	2,090	1,400	860	967	664	298
3	575	1,020	967	430	358	358	2,000	1,470	860	967	664	292
4	620	1,020	914	446	358	358	2,000	1,540	810	1,020	664	292
5	620	1,020	860	461	358	358	1,920	1,540	810	1,020	620	286
6	620	1,020	810	477	358	362	1,840	1,540	759	1,020	620	286
7	620	1,020	810	477	358	365	1,760	1,470	712	1,020	620	279
8	620	1,080	810	461	351	380	1,680	1,400	712	1,080	620	279
9	620	1,080	860	446	351	394	1,610	1,330	759	1,080	575	292
10	620	1,080	860	430	351	454	1,400	1,200	810	1,020	575	305
11	620	1,080	860	415	344	567	1,260	1,080	860	1,020	575	305
12	620	1,080	914	415	344	712	1,080	1,020	914	967	558	318
13	620	1,020	914	415	331	810	1,020	1,020	967	967	542	318
14	620	1,020	860	408	331	967	914	914	1,020	967	525	331
15	575	967	860	408	324	1,080	860	860	1,080	914	509	344
16	575	967	810	401	318	1,330	860	810	1,080	914	492	351
17	558	967	759	401	312	1,680	810	712	1,080	860	477	358
18	558	914	712	401	312	1,840	810	664	1,020	860	461	358
19	575	914	664	394	316	1,840	810	620	967	810	446	358
20	664	860	620	394	319	1,920	810	620	914	759	430	365
21	712	810	542	401	324	1,920	810	620	860	759	415	365
22	759	759	477	401	328	2,000	810	664	860	712	401	372
23	759	759	415	387	331	2,000	860	664	810	712	387	372
24	810	712	394	387	334	2,000	860	712	810	712	372	380
25	810	712	394	380	338	2,090	967	712	759	712	358	387
26	860	712	387	380	341	2,180	1,020	759	759	712	344	394
27	860	759	401	372	344	2,180	1,080	759	712	712	331	401
28	914	860	415	372	348	2,260	1,080	759	759	664	318	401
29	967	860	415	372	....	2,260	1,200	810	810	664	318	408
30	967	860	415	372	....	2,180	1,260	810	810	664	312	415
31	967	....	415	365	....	2,090	....	860	....	664	305	....

NOTE.—The above tables do not include small amount of water used to operate grist mill. See "Diversions" in station description.

Monthly discharge of Fox River at Algonquin, Ill., for the years ending Sept. 30, 1916 and 1917.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1915–16.					
October	2,430	810	1,470	1.10	1.27
November	1,020	492	616	.460	.51
December	1,080	477	718	.536	.62
January	3,480	500	1,260	.940	1.09
February	2,940	1,140	1,790	1.34	1.44
March	6,070	712	1,580	1.18	1.36
April	5,860	1,540	2,710	2.02	2.25
May	1,540	664	714	.533	.61
June	2,260	620	1,530	1.14	1.27
July	860	238	412	.307	.35
August	331	209	287	.214	.25
September	524	305	410	.306	.34
The year	6,070	209	1,120	.836	11.36
1916–17.					
October	976	542	690	.515	.59
November	1,080	712	929	.693	.77
December	967	387	691	.516	.59
January	477	365	410	.306	.35
February	365	312	340	.254	.26
March	2,260	351	1,280	.955	1.10
April	2,090	810	1,250	.933	1.04
May	1,540	620	989	.738	.85
June	1,080	712	860	.642	.72
July	1,080	664	864	.645	.74
August	664	305	489	.365	.42
September	415	279	340	.254	.28
The year	2,260	279	764	.570	7.71

FOX RIVER AT WEDRON, ILL.

LOCATION.—In sec. 9, T. 34 N., R. 4 E., at highway bridge at Wedron, La Salle County, about 1,000 feet above Buck Creek.

DRAINAGE AREA.—2,500 square miles.

RECORDS AVAILABLE.—November 5, 1914, to September 30, 1917.

GAGE.—Chain gage attached to bridge; read by Nels Mathias.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge.

CHANNEL AND CONTROL.—Bed of river at measuring section is soft and probably shifts. Control about 1,000 feet downstream composed of coarse gravel and large boulders; seldom shifts.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.6 feet at 4 p. m. March 14 (discharge, 10,200 second-feet); minimum stage, 5.90 feet at 4 p. m. September 4 (discharge 297 second-feet).

1915–1917: Maximum stage recorded, 15.4 feet March 14, 1916 (discharge not determined because of backwater from ice); maximum open-water stage recorded, 13.8 feet March 29, 1916 (discharge, 16,700 second-feet); minimum stage, 5.62 feet November 20, 1914 (discharge, 105 second-feet, by current-meter measurement).

REGULATION.—Moderate diurnal fluctuation is caused by operation of power plants at and above Montgomery.

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation changed slightly by high water in March. Rating curve used to March 10 well defined between 275 and 11,300 second-feet; curve used after that date well defined between 1,130 and 11,300 second-feet, and fairly well defined beyond these limits. Gage read to hundredths twice daily. Diurnal fluctuation only moderate. Daily discharge ascertained by applying mean daily gage heights to rating tables. Results good for medium and high stages, fair for very low stages, and poor for periods of ice effect.

The following discharge measurement was made by H. C. Beckman:

August 9, 1917: Gage height, 6.52 feet; discharge, 743 second-feet.

Daily discharge, in second-feet, of Fox River at Wedron, Ill., for the year ending Sept 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	751	1,410	1,260				2,720	2,170	2,040	1,500	730	378
2	675	1,410	1,310				2,720	2,720	1,910	1,500	690	343
3	997	1,360	1,220				2,570	2,430	1,670	1,440	690	366
4	790	1,310	1,220				2,570	2,300	1,500	1,380	690	308
5	790	1,310	1,410	960	840	425	2,570	2,300	1,550	1,280	652	544
6	830	1,310	1,310				2,720	2,040	2,870	1,380	615	580
7	790	1,460	1,220				2,430	2,040	2,570	1,790	652	544
8	830	1,220	1,220				2,170	2,040	1,910	1,550	709	510
9	751	1,460	1,360				2,040	1,790	1,910	1,380	690	402
10	954	1,410	1,310				1,910	1,790	2,170	1,440	652	384
11	830	1,460				2,040	1,670	1,670	2,040	1,380	652	477
12	871	1,410				3,330	1,610	1,550	1,910	1,380	580	580
13	954	1,310				6,460	1,550	1,440	5,520	1,380	580	402
14	997	1,310				9,620	1,550	1,330	5,080	1,280	615	366
15	871	1,310	1,140	720	485	4,870	1,380	1,330	3,860	1,230	615	414
16	790	1,260				4,870	1,280	1,180	3,170	1,180	580	414
17	830	1,220				4,450	1,330	1,080	2,720	1,380	615	343
18	830	1,180				3,020	1,280	940	2,300	1,230	510	446
19	638	1,220				2,720	1,380	852	2,040	1,230	477	652
20	954	1,080				3,020	1,440	1,230	1,790	1,380	446	477
21	1,710	1,310				2,870	1,440	985	1,670	1,080	652	477
22	1,710	1,220				2,870	1,280	1,330	1,550	1,030	652	510
23	1,260	1,360				3,680	1,230	1,440	1,500	1,330	510	544
24	1,360	1,710				4,050	1,500	1,380	1,440	1,550	477	446
25	1,410	1,310			440	3,020	1,500	1,130	1,330	1,280	477	544
26	1,410	1,260	915	685		3,330	1,670	1,230	1,550	1,180	414	510
27	1,410	1,040				3,170	1,670	2,170	1,500	1,030	378	544
28	1,410	1,180				3,170	1,610	1,670	1,380	940	378	544
29	1,310	1,220			......	2,870	1,790	1,610	1,440	810	544	580
30	1,360	1,130			......	3,330	1,670	1,610	1,550	730	414	544
31	1,560	......			......	2,870	......	1,670	......	810	390	......

NOTE.—Discharge Dec. 11 to Mar. 10, estimated, because of ice, from gage heights, observer's notes, and weather records. Braced figures show mean discharge for periods indicated.

Monthly discharge of Fox River at Wedron, Ill., for the year ending Sept. 30, 1917.

[Drainage area, 2,500 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,710	638	1,050	0.420	0.48
November	1,710	1,040	1,300	.520	.58
December	1,410	....	1,110	.444	.51
January	....	....	785	.314	.36
February	....	....	599	.240	.25
March	9,620	....	2,710	1.08	1.24
April	2,720	1,230	1,810	.724	.81
May	2,720	852	1,630	.652	.75
June	5,520	1,330	2,180	.872	.97
July	1,790	730	1,270	.508	.59
August	769	378	574	.230	.27
September	652	308	472	.189	.21
The year	9,620	....	1,290	.516	7.02

VERMILION RIVER NEAR STREATOR, ILL.

LOCATION.—In sec. 1, T. 30 N., R. 3 E. third principal meridian, at highway bridge known as Bridge No. 3, about 1½ miles south of Streator, La Salle County, and 100 feet below Santa Fe Railway bridge.

DRAINAGE AREA.—1,080 square miles.

RECORDS AVAILABLE.—July 27, 1914, to September 30, 1917.

GAGE.—Chain gage attached to highway bridge; read by Mark Morse.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Gravel and rocks; probably permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.8 feet at 4 p. m. June 6 (discharge, 5,750 second-feet); minimum stage, 0.52 foot at 9.30 a. m., October 1 (discharge, 1.3 second-feet).

1914–1917: Maximum stage recorded, 22.4 feet January 21, 1916 (discharge, estimated from extension of rating curve, 16,000 second-feet); minimum stage 0.45 foot August 16 and 17, 1914 (discharge, 0.7 second-foot).

ACCURACY.—Stage-discharge relation permanent; seriously affected by ice during winter. Rating curve well defined between 300 and 2,500 second-feet, and fairly well defined between 10 and 300 second-feet and between 2,500 and 12,000 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good for open-water periods, except for extremely low stages and for a period just before or after May 13, when the gage was probably read 1.0 foot in error; poor for period of ice effect.

Discharge measurements of Vermilion River near Streator, Ill., during the year ending Sept. 30, 1917.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Aug. 9	1.00	22.7
9	1.00	22.7

Daily discharge, in second-feet, of Vermilion River near Streator, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.3	6.9	19				332	716	228	278	45	16
2	2.5	7.3	18				434	716	216	252	27	15
3	3.0	6.5	25			240	783	684	304	204	19	16
4	1.8	7.3	23				854	684	278	193	17	9.4
5	3.0	5.2	22	570	310		891	684	464	146	24	8.6
6	3.8	5.2	22			105	1,130	684	5,750	102	19	11
7	2.5	7.3	30			102	2,270	652	5,400	88	16	109
8	1.5	10	42			96	930	652	4,680	77	17	318
9	1.6	15				88	891	652	4,680	72	16	304
10	1.6	22				88	854	652	4,680	67	16	318
11	1.8	24				193	818	620	4,600	56	15	318
12	5.2	24				182	749	620	3,720	48	14	318
13	5.2	11				5,400	716	304	4,520	47	12	278
14	5.2	11	25			2,210	588	304	3,640	13	7.7	150
15	5.2	12		215	90	2,210	495	291	3,560	27	4.7	34
16	5.2	12				2,150	464	291	3,560	16	5.2	30
17	2.5	12				1,850	419	291	1,650	240	6.0	27
18	5.6	12				1,170	652	291	1,170	111	2.5	22
19	5.6	12				749	749	278	818	107	4.7	16
20	7.3	15				1,090	818	278	783	105	3.8	10
21	15	18				1,050	854	265	716	93	3.6	8.6
22	15	15				1,010	854	252	464	85	3.8	9.4
23	12	24				1,010	818	252	464	81	25	11
24	15	25				970	818	252	464	81	22	9.4
25	14	30			145	930	783	252	375	81	32	9.0
26	11	29	20	350		854	783	240	332	133	28	8.1
27	9.4	26				749	749	240	252	131	26	6.0
28	9.4	15				684	749	240	265	133	24	16
29	5.2	18			......	652	749	228	278	111	22	17
30	5.6	18			......	526	716	228	278	88	32	18
31	5.6	......			......	318	......	228	......	80	28	......

NOTE.—Discharge Dec. 9 to Feb. 28 estimated, because of ice, from gage heights, observer's notes, and weather records. Braced figures show mean discharge for periods indicated. Gage probably read 1.0 foot in error for a period just before or after May 13, and computed discharge may be considerably in error.

Monthly discharge of Vermilion River near Streator, Ill., for the year ending Sept. 30, 1917.

[Drainage area, 1,080 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	15	1.3	6.08	0.006	0.007
November	30	5.2	15.2	.014	.02
December			22.6	.021	.02
January			377	.349	.40
February			184	.170	.18
March	5,400		891	.825	.95
April	2,270	332	790	.731	.82
May	716	228	420	.389	.45
June	5,750	216	1,950	1.81	2.02
July	278	13	108	.100	.12
August	45	2.5	17.4	.016	.02
September	318	6.0	81.4	.075	.08
The year	5,750	1.3	404	.374	5.09

SPOON RIVER AT SEVILLE, ILL.

Location.—In sec. 24, T. 6 N., R. 1 E. fourth principal meridian, at Toledo, Peoria & Western Railway bridge about a quarter of a mile east of railway station at Seville, Fulton County.

Drainage area.—1,600 square miles.

Records available.—July 24, 1914, to September 30, 1917.

Gage.—Chain gage attached to bridge; read to hundredths once daily by C. D. Bartlett. Elevation of zero gage above sea level, 467.78 feet.

Discharge measurements.—Made from downstream side of bridge; low water measurements are made by wading below dam at railroad station.

Channel and control.—Control is a loose rock dam, about 2 miles downstream from gage, used to create a reservoir for the pumping station of the Toledo, Peoria & Western Railway.

Extremes of stage.—Maximum stage recorded during year, 20.4 feet at 7 a. m. June 15; minimum stage, 2.10 feet at 7 a. m. October 11.

1914–1917: Maximum stage recorded, 26.0 feet January 23, 1916; minimum stage, 1.35 feet July 31, August 28 and 29, 1914.

Ice.—Stage-discharge relation affected by ice during winter.

Data inadequate for determination of discharge.

Discharge measurements of Spoon River at Seville, Ill., during the year ending Sept. 30, 1917.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Mar. 15	17.05	9,400	Sept. 7	4.39	594
18	7.27	2,080	17	3.19	177

Daily gage height, in feet, of Spoon River at Seville, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.80	3.1	3.3	4.5	7.5	4.1	4.0	10.7	5.5	6.8	3.85	2.87
2	2.50	2.90	3.2	4.3	6.7	4.1	4.0	9.2	5.5	6.5	3.65	2.56
3	2.45	3.0	3.2	3.9	5.5	3.7	3.85	7.1	4.9	6.2	3.55	2.46
4	2.40	3.0	3.2	3.7	5.0	3.8	3.65	7.0	4.6	5.1	3.30	3.8
5	2.25	3.0	3.2	4.7	4.5	3.6	4.0	7.0	18.2	5.1	3.3	3.95
6	2.20	3.0	3.1	6.5	4.5	3.3	4.15	5.3	15.1	5.0	3.25	......
7	2.20	2.90	3.1	9.5	4.3	3.3	4.25	4.8	14.2	4.2	3.2	4.45
8	2.20	2.90	3.1	9.0	4.2	3.5	4.15	4.6	12.1	4.0	3.1	4.7
9	2.20	4.2	3.1	7.5	4.0	3.6	4.0	4.25	9.0	3.85	3.1	5.8
10	2.20	4.4	3.4	6.3	3.9	3.5	4.2	4.9	8.7	5.2	2.85	8.6
11	2.10	4.1	3.2	5.4	4.0	3.95	4.3	5.0	8.5	4.8	2.75	9.2
12	2.15	3.9	3.0	5.0	4.3	4.45	4.15	4.9	8.1	4.4	2.65	7.4
13	2.25	3.6	2.70	4.8	4.3	10.1	3.6	4.8	15.4	4.25	2.6	7.0
14	2.40	3.4	3.0	4.5	4.5	15.6	3.75	4.5	17.2	4.05	3.6	6.8
15	2.50	3.3	3.0	4.5	4.7	16.4	3.8	4.45	20.4	3.9	3.55	5.7
16	2.60	3.1	3.0	4.4	4.8	17.5	3.6	4.3	18.4	3.75	3.3	4.6
17	2.55	3.1	2.90	4.4	4.1	11.6	3.65	4.15	15.1	5.4	3.1	3.2
18	2.50	3.2	2.80	4.2	......	7.3	4.7	4.1	12.2	5.1	3.0	4.4
19	2.50	3.2	2.70	4.0	......	7.0	5.0	4.0	10.2	4.0	2.88	4.4
20	2.50	3.2	2.80	4.0	......	6.6	8.6	3.85	8.1	3.05	2.72	4.5
21	3.8	3.1	2.80	4.0	3.8	6.6	7.7	3.75	6.4	2.47	2.43	4.45
22	4.3	3.2	2.80	8.0	3.8	6.5	6.0	3.95	6.2	3.2	5.2	4.35
23	3.5	3.4	2.80	11.6	3.8	8.6	5.6	4.15	6.1	3.1	4.15	4.3
24	3.6	3.7	2.80	8.8	3.8	8.6	6.1	4.0	6.1	4.15	4.0	4.2
25	3.7	3.6	2.80	7.8	3.8	6.3	6.5	3.9	5.8	6.2	3.85	4.1
26	3.8	3.4	2.80	6.2	3.9	4.7	6.3	3.85	5.8	5.1	3.7	3.95
27	4.0	3.4	5.3	5.3	4.0	4.45	6.4	4.0	5.6	4.5	3.5	3.95
28	3.9	3.4	7.9	5.1	4.0	4.2	6.6	3.7	6.5	4.05	3.1	3.9
29	3.6	3.4	6.3	6.0	......	4.2	6.6	3.65	8.3	3.9	3.6	3.85
30	3.4	3.3	5.5	5.2	......	4.1	7.2	3.55	5.8	3.75	3.5	3.8
31	3.3	......	5.1	5.2	......	4.0	......	5.4	......	4.05	3.25	......

NOTE.—Stage-discharge relation probably affected by ice about Dec. 11 to Mar. 11.

SANGAMON RIVER AT MONTICELLO, ILL.

LOCATION.—In sec. 12, T. 18 N., R. 5 E. third principal meridian, at Illinois Central Railroad bridge about half a mile west of Monticello, Piatt County.

DRAINAGE AREA.—550 square miles.

RECORDS AVAILABLE.—February 4, 1908, to December 31, 1912; June 23, 1914, to September 30, 1917.

GAGE.—Chain gage attached to downstream side of bridge; read by David Coay.

DISCHARGE MEASUREMENTS.—Made by wading or from downstream side of bridge and wooden trestle approach.

CHANNEL AND CONTROL.—Measuring section is at a pool; control consists of fine gravel; likely to shift.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 12.0 feet at 5 p. m. June 9 (discharge, 2,530 second-feet); minimum stage, 1.7 feet, October 9–11, 14, and 16–17 (discharge, 8 second-feet).

Maximum stage recorded during periods of records, 15.2 feet May 14, 1908 (discharge, 9,280 second-feet); maximum stage during flood of March to April, 1913, 17.7 feet March 25 (discharge not known); minimum stage recorded during periods of records, 1.5 feet July 31, August 1 and 3, 1914 (discharge, 1 second-foot).

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation changed slightly several times during year. Rating curve used from March 16 to August 4 fairly well defined above 51 second-feet; curves for remainder of year fairly well defined above 5 second-feet. Gage read to quarter-tenths once a day. Daily discharge ascertained by applying daily gage height to rating table. Open-water records good; winter records poor.

Discharge measurements of Sangamon River at Monticello, Ill., during the year ending Sept. 30, 1917.

[Made by H. C. Beckman.

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
July 27	6.36	483
Aug. 13	3.24	88.8
Do	3.23	87.4

Daily discharge, in second-feet, of Sangamon River at Monticello, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	10	12	17			34	244	186	391	443	63	67
2	12	12	17			29	326	186	619	358	48	54
3	12	11	17			29	659	211	522	295	31	42
4	9.5	11	17			32	815	211	425	240	22	36
5	9.5	11	17	20	25	34	639	237	659	186	239	32
6	9.5	11	17			29	745	340	1,500	151	456	29
7	9.5	11	20			25	865	442	1,980	130	618	29
8	8.8	11	24			21	724	358	2,400	116	715	194
9	8.0	12	24			23	582	295	2,530	101	508	218
10	8.0	14	24			24	450	251	2,340	88	226	242
11	8.0	14				24	358	211	2,160	75	140	148
12	9.5	14				25	295	174	2,280	63	113	96
13	9.5	14				490	251	152	2,040	59	86	75
14	8.0	14				1,100	211	130	1,770	55	69	59
15	8.0	14	16	10	8	1,320	186	115	1,380	74	53	48
16	8.0	14				1,540	162	101	1,090	92	49	40
17	8.0	14				1,340	140	88	918	88	36	32
18	11	14				980	130	88	745	88	33	25
19	14	14				619	140	83	619	83	27	23
20	14	14				488	162	77	510	71	21	23
21	17	14				358	162	71	425	55	21	23
22	17	14				295	174	88	358	48	100	23
23	17	17				265	186	125	1,150	40	165	21
24	17	21			30	342	151	237	804	30	194	19
25	17	21	12	25		453	125	326	459	48	194	19
26	14	22				564	120	265	358	59	134	19
27	14	23				425	151	226	408	342	73	19
28	14	23				310	130	186	493	528	65	19
29	13	21			......	211	146	186	619	357	46	19
30	12	21			......	186	162	140	528	186	73	16
31	12	......			......	162	......	265	......	96	86	......

NOTE.—Discharge interpolated for Sundays and July 4 and 10; estimated, because of ice, for Dec. 11 to Feb. 28, from gage heights, observer's notes, and weather records. Braced figures show mean discharge for periods indicated.

Monthly discharge of Sangamon River at Monticello, Ill., for the year ending Sept. 30, 1917.

[Drainage area, 550 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	17	8.0	11.6	0.021	0.02
November	23	11.0	15.1	.027	.03
December	....	....	15.7	.029	.03
January	....	....	18.6	.034	.04
February	....	....	20.4	.037	.04
March	1,540	21	380	.691	.80
April	865	120	320	.582	.65
May	442	71	195	.354	.41
June	2,530	358	1,080	1.96	2.19
July	528	30	150	.273	.31
August	715	21	152	.276	.32
September	242	16	57.0	.103	.11
The year	2,530	....	201	.365	4.95

SANGAMON RIVER AT RIVERTON, ILL.

Location.—In southeast corner of SW. ¼ sec. 9, T. 16 N., R. 4 W. third principal meridian, at Wabash Railroad bridge about a quarter of a mile west of Riverton, Sangamon County, and 2½ miles below mouth of South Fork.

Drainage area.—2,560 square miles.

Records available.—February 13, 1908, to December 31, 1912; August 7, 1914, to September 30, 1917.

Gage.—Chain gage attached to bridge; read by J. J. Washburn.

Discharge measurements.—Made from downstream side of bridge or by wading.

Channel and control.—Measuring section is at a pool; control consists of fine gravel and shifts slightly.

Extremes of discharge.—Maximum stage recorded during year, 27.4 feet at 4.30 p. m. June 7 (discharge, 19,900 second-feet); minimum stage, 7.43 feet at 8 a. m. November 21 (discharge, 37 second-feet).

1908–1912; 1914–1917: Maximum stage recorded, 27.8 feet February 3, 1916 (discharge, 20,800 second-feet); high water of 1883 reached a height of about 32 feet on the present gage, and that of 1875 is said to have been one-half foot lower (discharge not estimated); minimum stage recorded, 6.9 feet October 3–15, 1915 (discharge, 3 second-feet).

Ice.—Stage-discharge relation seriously affected by ice.

Accuracy.—Stage-discharge relation changed slightly during March. Rating curves used before and after the change, well defined below and fairly well defined above 4,350 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good for periods for which daily discharge has been ascertained; fair for October; poor for winter.

Discharge measurements of Sangamon River at Riverton, Ill., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
June 6	G. J. Trinkaus	27.80	21,600
July 28	H. C. Beckman	10.54	657
Sept. 10	....do	12.16	1,260

Daily discharge, in second-feet, of Sangamon River at Riverton, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		50	74			162	1,730	1,250	3,420	2,230	404	490
2		50	68			152	2,380	1,370	3,860	1,780	404	515
3		50	72			162	2,330	1,410	3,790	1,690	404	676
4		42	71			152	2,280	1,410	3,790	1,210	380	490
5		53	70	340	75	162	2,430	1,730	9,800	1,060	278	490
6		48	65			152	2,380	2,180	19,200	1,030	236	592
7		46	67			142	2,380	1,930	19,900	927	416	619
8		50	102			124	2,280	1,830	18,300	706	706	894
9		54	106			102	2,180	1,880	14,600	676	706	1,140
10		58	74			106	2,180	1,780	14,900	592	676	1,140
11		67				109	1,780	1,780	9,800	566	592	894
12		64				111	1,650	1,610	9,440	592	619	647
13		55				5,160	1,410	1,410	9,980	490	465	592
14		59				7,580	1,370	1,210	9,980	465	368	676
15		48	45	140		11,100	1,100	1,170	9,100	440	332	404
16	55	47				8,780	995	960	8,300	416	248	380
17		47			75	9,100	995	894	8,010	392	236	344
18		48				7,720	960	862	6,120	392	229	308
19		46				5,420	960	862	5,610	380	192	151
20		47				5,070	894	894	4,420	380	168	121
21		37				4,000	862	676	2,830	380	232	102
22		44				3,420	1,100	894	2,380	368	380	99
23		56				2,680	900	995	2,080	894	515	100
24		83			217	2,530	706	960	1,780	894	676	105
25		116			228	2,480	676	960	1,610	619	490	97
26		116	40	100	252	2,380	619	995	1,490	465	416	94
27		104			217	1,930	706	995	1,490	490	465	102
28		99			162	1,780	1,030	1,030	3,120	566	404	113
29		99			......	1,610	1,030	1,060	2,940	619	392	105
30		93			......	1,370	1,060	1,370	2,380	619	440	71
31		......			......	1,210	......	2,680	......	566	465	......

NOTE.—Discharge, Oct. 1 to Nov. 3, estimated because of no gage-height record, from records of discharge of Sangamon River at Monticello and at Oakford; also Dec. 11 to Feb. 23, because of ice, from gage heights, observer's notes, and weather records. Braced figures show mean discharge for periods indicated.

Monthly discharge of Sangamon River at Riverton, Ill., for the year ending Sept. 30, 1917.

[Drainage area, 2,560 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	....	....	55.0	0.021	0.02
November	116	37	62.5	.024	.03
December	106	....	53.5	.021	.02
January	....	....	190	.074	.09
February	252	....	100	.039	.04
March	11,100	102	2,800	1.09	1.26
April	2,430	619	1,450	.566	.63
May	2,680	676	1,320	.516	.59
June	19,900	1,490	7,150	2.79	3.11
July	2,230	368	739	.289	.33
August	706	168	417	.163	.19
September	1,140	71	419	.164	.18
The year	19,900	....	1,230	.480	6.49

SANGAMON RIVER NEAR OAKFORD, ILL.

LOCATION.—In sec. 6, T. 19 N., R. 7 W. third principal meridian, at highway bridge 3 miles northeast of Oakford, Menard County, 2½ miles above Chicago, Peoria & St. Louis Railway bridge, and 1½ miles above mouth of Crane Creek.

DRAINAGE AREA.—5,000 square miles.

RECORDS AVAILABLE.—October 26, 1909, to June 30, 1911; December 10, 1911, to March 31, 1912; August 25, 1914, to September 30, 1917.

GAGE.—Chain gage attached to bridge; read by R. W. Schnell.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of sand and fine gravel; shifting. The river for some distance above and below station has been dredged and straightened, thus increasing the slope considerably and disturbing the regimen of flow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 19.9 feet June 8 and 9 (discharge, determined from extension of rating curve, 33,300 second-feet); minimum stage, 0.68 foot October 10–18 (discharge, 135 second-feet).

1909–1912, 1914–1917: Maximum discharge June 8, 9, 1917; minimum discharge, 85 second-feet, August 30, 31, November 27, and December 2, 1914.

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation not permanent. Rating curve used to March 31, 1916, fairly well defined between 310 and 17,500 second-feet; curves used after that date fairly well defined between 170 and 17,500 second-feet; extended above 17,500 second-feet. Gage read to tenths once daily till December 31, 1914, and to hundredths once or twice daily afterwards. Gage reading for March to September, 1916, somewhat unreliable. Daily discharge ascertained by applying daily gage height to rating table. Open-water records good for medium stages, and fair for low and very high stages; winter records poor.

Discharge measurements of Sangamon River near Oakford, Ill., during the year ending Sept. 30, 1917.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Nov. 3	0.77	158	Mar. 28	6.34	3,540
Mar. 16	11.98	10,000	June 27	6.40	2,950
21	10.48	8,160	Sept. 8	2.57	755

Daily discharge, in second-feet, of Sangamon River near Oakford, Ill., for the years ending Sept. 30, 1914–1917.

Day.	Aug.	Sept.	Day.	Aug.	Sept.	Day.	Aug.	Sept.
1914.								
1		99	11		427	21		348
2		237	12		407	22		348
3		274	13		387	23		329
4		310	14		387	24		310
5		329	15		387	25	117	310
6		348	16		387	26	117	310
7		348	17		387	27	99	292
8		348	18		374	28	99	273
9		468	19		361	29	99	273
10		468	20		348	30	85	273
						31	85	

Daily discharge, in second-feet, of Sangamon River near Oakford, Ill., for the years ending Sept. 30, 1914–1917—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1914–15.												
1	202	99	99	......	......	......	448	696	15,900	1,670	7,000	12,800
2	140	99	85	......	......	......	448	600	14,500	1,880	7,520	10,480
3	140	99	92	......	......	......	427	554	12,800	1,810	9,360	6,880
4	132	99	99	......	......	......	427	696	9,920	1,670	10,800	4,330
5	124	99	99	......	......	......	427	600	8,560	1,530	10,500	3,770
6	117	99	99	......	......	......	407	510	6,280	1,320	9,500	3,060
7	99	99	99	......	......	......	407	554	4,730	1,390	7,520	2,900
8	140	99	99	......	......	......	387	906	4,130	1,810	5,820	2,740
9	128	99	117	......	......	......	368	1,460	3,410	2,500	5,600	2,900
10	117	99	117	......	......	......	427	1,020	2,740	2,900	5,710	2,980
11	117	99	117	......	......	......	647	798	2,740	6,160	5,270	3,770
12	117	99	117	......	......	......	798	647	3,140	8,690	4,940	4,530
13	117	99	117	......	......	......	798	600	5,160	8,820	3,860	5,160
14	117	99	117	......	......	......	746	600	5,600	8,690	2,740	3,950
15	117	99	99	......	......	......	746	554	5,270	8,560	2,340	6,760
16	117	99		......	......	......	696	468	4,730	9,080	2,020	10,900
17	117	99		......	......	......	647	407	3,950	9,220	2,740	9,640
18	117	99		......	......	......	600	368	3,060	7,780	2,900	9,920
19	117	99		......	......	696	554	329	2,580	6,280	1,880	9,220
20	117	99		......	......	647	798	310	2,740	4,530	1,810	8,300
21	117	99		......	......	600	510	407	2,980	3,410	7,280	8,820
22	117	99		......	......	600	510	448	3,410	2,660	11,300	8,430
23	117	99	100	......	......	600	647	427	4,330	2,180	12,600	7,780
24	108	99		......	......	600	696	427	4,730	1,740	14,700	6,640
25	99	99		......	......	554	746	468	4,530	1,530	17,500	5,380
26	99	92		......	......	510	798	6,160	3,060	1,810	20,600	4,940
27	99	85		......	......	489	851	9,220	2,420	2,340	22,200	4,730
28	99	92		......	......	489	906	11,200	1,950	2,180	21,400	4,330
29	99	99		......	......	468	906	13,700	1,740	2,100	20,200	3,860
30	99	99		......	......	468	851	16,300	1,600	2,260	16,900	3,590
31	99	......		......	......	448	......	16,500	......	4,830	14,700	......
1915–16.												
1	2,980	851	600	2,420	......	......	5,380	1,810	3,770	1,740	363	211
2	2,980	851	554	4,730	......	7,260	5,270	1,810	3,590	1,470	363	203
3	2,740	798	532	7,910	......	6,040	5,160	1,810	3,430	1,350	345	196
4	2,580	798	532	9,920	25,800	5,160	5,160	1,810	3,190	1,230	327	173
5	2,420	798	554	10,200	28,400	......	4,830	1,810	2,790	1,110	292	167
6	2,180	746	600	10,300	......	......	4,530	1,810	2,630	1,000	292	167
7	2,020	746	647	10,200	20,200	......	4,130	1,740	2,950	896	292	167
8	1,880	696	600	9,780	......	......	3,860	1,670	3,110	845	538	162
9	1,740	696	600	9,360	13,400	......	3,590	1,600	3,270	795	419	167
10	1,670	696	600	8,820	......	......	3,430	1,530	3,110	746	345	154
11	1,600	696	647	8,170	......	......	3,270	1,470	2,790	698	538	154
12	1,530	696	696	8,820	......	4,630	3,110	1,470	2,550	698	651	154
13	1,460	696	798	0,900	......	4,530	2,950	1,530	2,310	698	698	173
14	1,460	696	851	10,500	......	4,130	2,870	3,110	2,160	698	560	162
15	1,390	696	1,080	11,200	......	3,950	2,790	3,430	2,020	698	477	154
16	1,320	696	1,390		......	3,770	2,790	4,040	1,880	605	345	154
17	1,320	647	1,320		......	3,590	2,630	4,040	1,740	582	327	154
18	1,260	624	1,320		......	3,500	2,470	3,680	1,740	538	327	154
19	1,260	647	1,320		......	3,410	2,390	3,350	1,670	517	327	154
20	1,260	696	1,390		......	3,230	2,390	3,110	1,600	497	259	154
21	1,200	696	1,390		......	3,140	2,390	3,030	1,670	560	276	154
22	1,200	696	1,460		......	3,140	2,310	2,950	1,950	605	259	154
23	1,140	696	1,390		......	3,140	2,310	2,630	3,430	651	259	147
24	1,140	696	1,390	13,100	......	3,060	2,160	2,630	4,040	605	243	140
25	1,140	624	1,200		......	2,900	2,160	2,630	3,770	582	227	140
26	1,140	746	1,200		......	3,250	2,090	2,550	3,430	497	227	135
27	1,020	1,020	1,080		......	3,610	2,090	3,190	2,950	477	227	128
28	962	906	1,080		......	3,960	2,020	3,510	3,030	438	227	140
29	906	696	1,020		......	4,320	1,950	3,590	2,630	438	227	151
30	906	647	1,020		......	4,670	1,880	3,770	2,310	400	227	167
31	906	......	1 200		......	5,030	......	4,130	......	363	218	......

Daily discharge, in second-feet, of Sangamon River near Oakford, Ill., for the years ending Sept. 30, 1914–1917—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1916–17.												
1	190	173	259			477	2,550	2,470	4,730	5,550	1,100	746
2	167	173	227			438	3,110	2,630	5,600	5,550	980	798
3	167	154	243			438	4,040	2,710	5,490	4,080	860	746
4	162	154	227			400	4,530	2,950	5,160	3,320	750	696
5	156	154	221	750		363	4,630	3,190	12,200	2,790	650	647
6	156	154	212			363	4,730	3,430	17,100	2,400	650	574
7	148	145				382	5,160	3,590	30,200	2,190	650	574
8	148	154				382	4,830	3,430	32,600	1,980	750	798
9	140	167				363	4,530	3,270	33,300	1,770	1,280	746
10	135	173			245	327	4,040	3,590	30,200	1,560	1,040	1,950
11	135	167				327	3,680	3,430	28,000	1,490	1,040	1,600
12	135	181				327	3,430	3,110	25,800	1,300	1,040	1,390
13	135	181	205			497	3,110	2,790	23,600	1,240	939	1,260
14	135	181				5,600	2,710	2,630	21,500	1,110	838	1,080
15	135	167		455		8,300	2,870	2,230	19,300	1,050	736	906
16	135	167				10,100	2,310	2,160	17,100	1,220	635	696
17	135	167				11,000	2,090	1,950	15,700	1,220	586	598
18	135	167				11,600	2,020	1,880	14,200	1,160	538	524
19	148	167				10,800	2,790	1,740	13,100	1,100	491	500
20	184	167				9,360	2,710	1,600	11,900	1,100	468	452
21	173	167			327	8,040	2,630	1,530	10,800	980	610	428
22	187	167			400	6,520	2,310	2,310	9,640	920	1,900	382
23	187	212			477	5,380	2,090	2,630	8,560	920	925	359
24	187	243			477	4,940	1,950	2,390	6,700	1,100	980	337
25	193	259	215	325	477	4,730	1,810	2,310	5,110	1,400	925	337
26	187	259			560	4,430	1,670	2,230	3,880	1,220	867	337
27	173	259			560	3,950	1,810	2,160	3,050	1,720	814	337
28	173	259			517	3,590	2,090	2,090	6,100	1,460	711	337
29	173	259			......	3,270	2,160	2,160	7,300	1,340	635	315
30	173	259			......	3,030	2,310	2,390	6,460	1,220	660	315
31	181	......			......	2,710	......	3,350	......	1,160	610	......

NOTE.—Discharge interpolated for about one-third the days in 1914 and June 11–15, 1917; ascertained from estimated gage heights June 18–26, 1917; estimated, because of ice, from gage heights, observer's notes, and weather records, for Dec. 16–31, 1914, Dec. 16–31, 1915, and Dec. 7, 1916 to Feb. 20, 1917.
Gage-height record March to September, 1916, rather unreliable.

Monthly discharge of Sangamon River near Oakford, Ill., for the years ending Sept. 30, 1914–1917.

[Drainage area, 5,000 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1914.					
August 25–31	117	85	100	0.020	0.005
September	468	99	338	.068	.08
1914–15.					
October	202	99	118	.024	.03
November	99	85	98.1	.020	.02
December	....	....	102	.020	.02
March 19–31	696	448	551	.110	.05
April	906	368	621	.124	.14
May	16,500	310	2,840	.568	.65
June	15,900	1,600	5,090	1.02	1.14
July	9,080	1,320	3,980	.796	.92
August	22,200	1,810	9,330	1.87	2.16
September	12,800	2,740	6,120	1.22	1.36

Monthly discharge of Sangamon River near Oakford, Ill., for the year ending Sept. 30, 1914–1917—Continued.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1915–16.					
October	2,960	906	1,570	0.314	0.36
November	1,020	624	730	.146	.16
December	1,460	532	970	.194	.22
January	....	2,420	11,100	2.22	2.56
February	....	....	....	....	....
March	....	....	....	....	....
April	5,380	1,880	3,140	.628	.70
May	4,130	1,470	2,620	.524	.60
June	4,040	1,600	2,720	.544	.61
July	1,740	363	743	.149	.17
August	698	218	345	.069	.08
September	211	128	160	.032	.04
1916–17.					
October	190	135	160	.032	.04
November	259	145	189	.038	.04
December	....	....	214	.043	.05
January	....	....	504	.101	.12
February	560	....	311	.062	.06
March	11,600	327	3,950	.790	.91
April	5,160	1,670	3,020	.604	.67
May	3,590	1,530	2,590	.518	.60
June	33,300	3,050	14,500	2.90	3.24
July	5,550	920	1,830	.366	.42
August	1,900	468	828	.166	.19
September	1,950	315	692	.138	.15
The year	33,300	135	2,390	.478	6.49

SOUTH FORK OF SANGAMON RIVER NEAR TAYLORVILLE, ILL.

Location.—In sec. 8, T. 12 N., R. 2 W., at Wabash Railroad bridge about 3½ miles southwest of Taylorville, Christian County, and about a quarter of a mile upstream from highway bridge known as Half Acre Bridge.

Drainage area.—427 square miles.

Records available.—February 11, 1908, to December 31, 1912; August 8, 1914, to May 17, 1917, when station was discontinued.

Gage.—Chain gage attached to bridge; read by Louis Seelbach. On September 2, 1909, gage datum was lowered 2 feet. The gage heights to August 10, 1909, refer to old datum; those from August 11 to September 1, 1909, are of no value because of backwater from a construction dam built and used during that period. Gage heights from September 2, 1909, to December 31, 1912, refer to new datum. On August 8, 1914, the datum was changed by an unknown amount, all bench marks being destroyed during construction of a new concrete steel-plate girder bridge. Gage heights subsequent to August 8, 1914, refer to the datum used in reestablishing the gage on that date.

Discharge measurements.—Made from downstream side of bridge or by wading below gage.

Channel and control.—In August, 1909, a drainage ditch was dug along the river in the vicinity of the station, which straightened the course of the stream but coincided with the original channel at the gaging section. Though the cross section of the channel at the measuring section was not changed, the stage-discharge relation was considerably affected by the change in slope. Subsequent to 1912 a new bridge was built, and since then the stage-discharge relation has again changed. Measuring section is in a pool; control likely to shift.

Extremes of discharge.—1914–1917: Maximum stage recorded, 16.1 feet at 1 p. m. January 31, 1916 (discharge, 9,660 second-feet); minimum stage, 0.51 foot August 10 and 11 and September 29, 1914 (discharge, 0.6 second-foot).

Maximum discharge during periods of records same as for 1914–1917.

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation changed several times from 1914 to 1917; affected by ice and by backwater from brush during spring of 1917. Rating curves used from February 1, 1915, to March 31, 1917, fairly well defined between 264 and 2,520 second-feet; rating curves for other periods poorly defined. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records fair for medium and high stages during open-water periods of 1915 and 1916; poor for remainder of time.

Discharge measurements of South Fork of Sangamon River near Taylorville, Ill., during the year ending Sept. 30, 1917.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Mar. 17	9.34	1,530
Mar. 20	6.32	387
May 18	4.60	107

Daily discharge, in second-feet, of South Fork of Sangamon River near Taylorville, Ill., for the period Aug. 8, 1914, to May 17, 1917.

Day.	Aug.	Sept.	Day.	Aug.	Sept.	Day.	Aug.	Sept.
1914.			1914.			1914.		
1		2.7	11	0.6	32	21	2.0	2.1
2		2.8	12	.7	17	22	49	2.1
3		11	13	.7	13	23	29	2.0
4		18	14	2.7	9.2	24	10	1.6
5		14	15	1.6	7.8	25	7.4	1.3
6		14	16	1.3	6.8	26	4.4	1.1
7		45	17	1.1	6.0	27	9.0	1.0
8	0.7	190	18	.9	5.0	28	2.7	.9
9	.7	77	19	.8	3.8	29	3.2	.6
10	.6	43	20	6.0	3.0	30	3.4	1.2
						31	3.0	

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1914–15.												
1	1.3	2.7	7.0			98	18	19	1,670	558	167	473
2	1.4	2.7	7.2			85	17	16	1,320	383	190	332
3	1.4	2.8	8.0		1,520	68	17	28	985	264	536	248
4	1.4	3.0	8.0			63	17	42	581	190	558	178
5	1.3	3.2	8.8	75		58	16	38	400	315	605	148
6	1.1	3.4	8.4		1,570	63	17	36	264	400	400	148
7	1.2	3.6	8.2		1,270	68	17	40	190	315	190	126
8	1.3	4.4	9.2		790	63	17	140	167	493	126	126
9	3.6	5.2	10		349	63	18	105	140	851	91	148
10	3.6	6.0	9.8		140	54	20	85	119	790	85	133
11	3.0	5.8			133	48	38	48	1,180	1,470	68	112
12	3.0	5.8			98	46	50	40	1,570	2,060	63	105
13	2.8	6.2			85	44	58	30	1,720	2,530	58	105
14	2.7	7.0			85	42	42	25	1,270	2,380	54	98
15	2.6	7.4	3	30	85	40	34	28	761	2,000	54	91
16	5.2	7.4			73	38	30	28	400	1,620	68	98
17	5.0	7.0			68	34	21	30	217	1,370	105	79
18	5.0	6.2			54	32	19	24	167	851	85	126
19	4.6	6.0			50	31	17	17	140	473	148	349
20	4.0	6.0			42	32	17	20	315	315	167	349
21	4.0	6.0			36	32	17	36	1,270	217	3,210	264
22	3.8	6.0			34	31	19	157	1,370	178	7,150	383
23	3.2	6.4			85	30	190	105	1,470	140	5,990	264
24	2.7	6.4			315	28	264	79	950	119	4,230	167
25	2.2	6.6	8	5	473	26	454	73	605	98	2,940	157
26	2.1	7.0			332	25	366	654	248	98	2,310	112
27	2.1	7.0			178	25	203	3,030	140	167	1,620	105
28	2.1	7.0			119	21	112	3,390	157	157	1,370	105
29	2.1	6.8				20	68	2,770	315	140	950	119
30	2.2	6.8				20	26	2,380	680	119	680	105
31	2.4					19		2,000		140	605	

Daily discharge, in second-feet, of South Fork of Sangamon River near Taylorville, Ill., for the period Aug. 8, 1914, to May 17, 1917—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915-16.												
1	91	85	91		7,870	514	232	111	102	111	11	2.1
2	79	85	91		8,690	448	232	111	102	84	7.4	4.2
3	73	85	85		2,530	383	232	111	111	68	11	3.3
4	70	85	91		1,940	332	217	120	120	57	8.8	2.5
5	63	85	85	1,330	1,470	298	203	129	102	57	7.0	1.9
6	58	85	85		1,140	332	190	120	102	50	4.8	5.0
7	56	85	85		706	605	178	111	90	47	3.1	43
8	54	85	85		493	883	178	102	315	39	4.5	45
9	52	85	85		400	790	167	94	264	35	8.4	22
10	50	85	85		332	654	167	87	190	33	6.0	8.8
11	48	85	112	761	298	536	167	80	129	29	5.0	4.0
12	48	85	178	1,570	298	473	157	80	111	27	6.8	1.9
13	50	91	298	4,460	315	417	147	80	90	26	7.2	2.1
14	52	91	298	4,980	281	400	138	80	74	43	10	1.3
15	54	91	217	3,900	232	366	138	87	68	54	16	.9
16	56	91	178	3,030	232	332	129	102	65	35	18	1.1
17	58	85	232	2,450	417	298	129	203	62	31	17	1.0
18	60	85	383	2,060	605	248	120	157	60	31	15	1.1
19	73	91	435	1,720	883	264	120	120	57	26	7.6	1.1
20	85	98	366	1,320	851	232	120	94	74	24	5.0	1.1
21	85	98	264	1,180	761	217	157	87	733	90	3.5	1.9
22	79	98	232	1,420	761	217	157	84	1,520	43	2.9	1.5
23	79	98	203	1,670	1,100	217	147	80	1,880	37	2.3	1.3
24	73	98	203	1,670	1,320	203	138	77	1,720	27	2.1	1.1
25	73	98	203	1,420	1,420	203	120	74	1,370	21	1.7	.9
26	73	85		1,100	1,370	203	120	71	680	17	1.7	1.0
27	73	91		916	1,100	217	129	74	400	15	2.1	.9
28	79	91	165	1,100	820	264	129	80	264	12	1.5	5.2
29	79	91		1,370	629	264	120	102	190	11	1.9	3.1
30	85	91		2,850	......	264	111	111	147	9.6	1.5	1.9
31	85	......		9,460	......	248	......	102	......	7.8	1.7	......

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.
1916-17.								
1	1.3	11	11			19	107	224
2	1.1	10	10			15	192	283
3	1.1	9.6	9.6			12	435	340
4	1.3	10	9.6			12	385	301
5	1.3	9.6	9.8	45	1.5	11	266	283
6	1.1	9.6	9.6			10	249	301
7	.9	9.8	9.6			10	249	385
8	1.1	9.8	10			11	224	320
9	1.3	10				11	200	283
10	1.1	11				11	192	249
11	1.0	10				11	162	301
12	1.1	10				12	128	283
13	1.1	10				248	128	266
14	1.3	11				1,520	102	249
15	2.3	11	5	12	1.2	3,030	90	200
16	4.5	11				2,120	82	162
17	3.5	10				1,570	72	134
18	2.7	10				1,140	65	......
19	8.0	10				714	78	......
20	9.0	10				385	59	......
21	9.4	10				283	53	......
22	9.0	10				249	50	......
23	8.8	13				216	40	......
24	9.2	14			20	266	34	......
25	10	17				519	32	......
26	10	19	9	7		549	30	......
27	10	16				362	33	......
28	10	14				283	65	......
29	11	13			......	200	122	......
30	10	11			......	156	154	......
31	11	......			......	112	......	......

NOTE.—Discharge interpolated for Nov. 8 and 9, 1914, Mar. 2, 1916, and Mar. 30, 1917; estimated for Dec. 11, 1914, to Feb. 5, 1915, Jan. 1-10, 1916, and Dec. 9, 1916, to Feb. 28, 1917, because of ice, from gage heights, observer's notes, and weather records. Braced figures show mean discharge for periods indicated.

Monthly discharge of South Fork of Sangamon River near Taylorville, Ill., for the period Aug. 8, 1914 to May 17, 1917.

[Drainage area, 427 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1914.					
August, 8-31	49	0.6	5.90	0.014	0.01
September	190	.6	17.8	.042	.05
1914-15.					
October	5.2	1.1	2.72	.0064	.007
November	7.4	2.7	5.59	.013	.01
December			6.54	.015	.02
January			35.6	.083	.10
February		34	502	1.18	1.23
March	98	19	43.5	.102	.12
April	454	16	74.0	.173	.19
May	3,390	16	500	1.17	1.35
June	1,720	119	693	1.62	1.81
July	2,530	98	684	1.60	1.84
August	7,150	54	1,130	2.65	3.06
September	473	79	178	.417	.46
The year	7,150		321	.752	10.20
1915-16.					
October	91	48	67.5	.158	.18
November	98	85	89.4	.209	.23
December	435	85	183	.428	.49
January	9,460		2,060	4.82	5.56
February	7,870	232	1,180	2.76	2.98
March	883	203	365	.854	.98
April	232	111	156	.365	.41
May	203	71	101	.237	.27
June	1,880	57	373	.873	.97
July	111	7.8	38.6	.090	.10
August	18	1.5	6.53	.015	.02
September	45	.9	5.74	.013	.01
The year	9,460	.9	383	.897	12.20
1916-17.					
October	11	0.9	4.98	.012	.01
November	19	9.6	11.3	.026	.03
December			7.78	.018	.02
January			20.9	.049	.06
February			6.68	.015	.02
March	3,030	10	454	1.06	1.22
April	435	30	136	.319	.36
May, 1-17	385	134	268	.627	.40

SOUTH FORK OF SANGAMON RIVER AT POWER PLANT NEAR TAYLORVILLE, ILL.

LOCATION.—In sec. 14, T. 13 N., R. 3 W., at Chicago & Illinois Midland Railroad bridge about 6 miles northwest of Taylorville, Christian County, about 500 feet east of power plant of Central Illinois Public Service Co., 5 miles below mouth of Bear Creek, and 8 miles below station formerly maintained at Wabash Railroad bridge.

DRAINAGE AREA.—510 square miles (measured on map issued by U. S. Geological Survey, scale, 1 to 500,000).

RECORDS AVAILABLE.—May 18 to September 30, 1917.

AGE.—Chain gage attached to bridge; read by R. T. Teaney.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge or by wading.

CHANNEL AND CONTROL.—Soft mud; likely to shift.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period of records, 26.6 feet June 6 (discharge, 10,400 second-feet); minimum stage, 3.68 feet at 9 a. m. August 21 (discharge, 3.8 second-feet).

A stage of about 27.3 feet on the present gage is said to have been reached January 31, 1916 (discharge, 11,300 second-feet).

DIVERSIONS.—An average of about a half second-foot of water is used for boiler-feed and other purposes at the power plant.

ACCURACY.—Stage-discharge relation probably permanent during period of records. Rating curve fairly well defined above 25 second-feet. Gage read to hundredths twice a day. Daily discharge ascertained by applying daily gage height to rating table. Records good except those for extremely low stages, which are fair.

Discharge measurements of South Fork of Sangamon River at power plant near Taylorville, Ill., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 18	H. C. Beckman	5.61	102	June 8	G. J. Trinkaus	21.43	5,040
June 1	G. J. Trinkaus	14.21	1,430	26	H. C. Beckman	5.83	109
7	....do	24.62	8,090	Sept. 11	....do	9.72	504

Daily discharge, in second-feet, of South Fork of Sangamon River at power plant, near Taylorville, Ill., for the year ending Sept. 30, 1917.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1		1,440	155	23	116	16		680	23	7.6	34
2		1,380	108	14	87	17		535	21	6.4	27
3		1,350	96	11	59	18	96	390	19	5.6	20
4		1,230	76	8.6	30	19	88	300	17	5.0	17
5		5,020	62	11	24	20	82	240	15	4.4	15
6		10,400	52	14	22	21	76	200	13	3.9	16
7		8,310	47	220	32	22	96	191	19	70	15
8		5,020	42	59	806	23	220	164	25	522	14
9		3,310	38	96	743	24	330	146	33	240	12
10		2,390	35	62	680	25	300	128	128	137	11
11		1,750	32	40	412	26	240	112	200	84	10
12		1,410	28	28	146	27	370	96	116	32	14
13		1,150	26	16	92	28	663	112	146	73	17
14		868	23	12	59	29	956	124	99	280	16
15		680	23	9.0	42	30	1,150	200	52	350	13
						31	1,410		34	260	

NOTE.—No gage height record for May 20, June 17, July 8, 22, and 29, Aug. 5, 12, 19, and 26, and Sept. 2, 3, 9, 16, 23, and 30; discharge interpolated.

Monthly discharge of South Fork of Sangamon River at power plant near Taylorville, Ill., for the year ending Sept. 30, 1917.

[Drainage area, 510 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
May 18-31	1,410	76	434	0.851	0.44
June	10,400	96	1,640	3.22	3.59
July	200	13	58.2	.114	.13
August	522	3.9	87.1	.171	.20
September	806	10	120	.235	.26

KASKASKIA RIVER AT VANDALIA, ILL.

LOCATION.—In sec. 16, T. 6 N., R. 1 E. third principal meridian, at highway bridge at east end of Main Street, Vandalia, Fayette County, about 3½ miles above Hickory Creek.

DRAINAGE AREA.—1,980 square miles.

RECORDS AVAILABLE.—February 26, 1908, to December 31, 1912; August 11, 1914, to September 30, 1917.

GAGE.—Chain gage attached to bridge; read by Wilson Haley.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Measuring section is at a pool; may shift.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 23.0 feet at 9 p. m. June 6 (discharge, 16,400 second-feet); minimum stage, 0.52 foot October 14 and November 16 to 19 (discharge, 19 second-feet).

1908–1912 and 1914–1917: Maximum stage recorded, 23.0 feet June 6, 1917 (discharge, 16,400 second-feet); minimum stage, 0.38 foot August 12, 1914 (discharge, 13 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation changed during high water in June. Rating curve used till May 31 well defined between 270 and 10,800 second-feet; curve used after that date well defined between 327 and 10,800 second-feet; both curves fairly well defined beyond the limits mentioned. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Open-water records good; winter records poor.

Discharge measurements of Kaskaskia River at Vandalia, Ill., during the year ending Sept. 30, 1917.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Sept. 12	3.84	528
12	3.91	521

Daily discharge, in second-feet, of Kaskaskia River at Vandalia, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	28	22	43	473		254	1,270	3,690	6,660	1,500	685	552
2	28	22	42	520		222	3,890	2,460	8,600	1,440	603	458
3	28	21	36	568		185	2,340	1,580	7,560	1,300	458	307
4	27	20	36	619		153	1,480	1,480	6,880	1,260	369	231
5	26	20	34	1,380	110	147	2,100	1,860	9,340	1,190	348	196
6	26	20	34	2,500		141	1,940	2,220	11,100	1,130	307	180
7	24	20	37	1,690		136	1,800	2,180	9,820	950	770	165
8	23	20	105	1,100		147	1,580	2,140	8,060	830	1,190	950
9	22	28	120	912		141	1,440	2,100	7,560	685	685	770
10	20	24	130	730		130	1,340	2,020	7,560	630	552	528
11	20	21				125	1,240	1,980	6,990	552	369	458
12	19	22				172	1,100	1,720	6,180	504	327	528
13	19	21				2,300	976	1,580	5,930	481	287	458
14	19	20				4,090	820	1,380	5,280	458	231	391
15	20	19	125	115		3,940	760	1,270	4,470	435	213	327
16	20	19			160	3,690	730	1,100	4,190	413	196	268
17	21	19				3,440	673	1,040	4,040	391	172	222
18	22	19				3,040	619	976	3,390	435	158	196
19	28	19				2,740	568	912	2,720	391	138	172
20	32	19				2,660	544	790	2,480	369	132	158
21	43	19				2,560	520	730	2,160	327	231	132
22	41	20			407	2,460	496	2,500	1,750	287	1,010	108
23	40	40			386	2,140	473	2,660	1,400	327	630	102
24	38	60			344	2,840	473	1,550	1,300	391	504	96
25	36	56			305	3,090	429	1,340	1,190	307	435	96
26	33	36	410	145	287	2,460	407	1,240	1,070	287	327	96
27	30	34			287	1,960	429	1,170	980	369	249	90
28	28	49			270	1,760	2,580	2,500	1,100	577	165	84
29	24	46			......	1,520	3,090	4,040	1,330	1,160	458	78
30	24	46			......	1,380	3,940	3,490	1,780	1,010	713	72
31	23	......			......	1,140	......	5,490	......	830	630	......

NOTE.—Discharge interpolated for Mar. 21; estimated for Dec. 11 to Feb. 21, because of ice, from gage heights, observer's notes, and weather records. Braced figures show mean discharge for periods indicated.

Monthly discharge of Kaskaskia River at Vandalia, Ill., for the year ending Sept. 30, 1917.

[Drainage area, 1,980 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	43	19	26.8	0.014	0.02
November	60	19	27.4	.014	.02
December			206	.104	.12
January	2,500		427	.216	.25
February			184	.093	.10
March	4,090	125	1,650	.833	.96
April	3,940	407	1,360	.687	.77
May	5,490	730	1,970	.995	1.15
June	11,100	980	4,760	2.40	2.68
July	1,500	287	684	.345	.40
August	1,190	132	437	.221	.25
September	950	72	282	.142	.16
The year	11,100	19	1,000	.505	6.88

KASKASKIA RIVER AT NEW ATHENS, ILL.

Location.—In W. ½ NE. ¼ sec. 28, T. 2 S., R. 7 W. third principal meridian, at Illinois Central Railroad bridge about 600 feet north of railroad station at New Athens, St. Clair County, about a mile below mouth of Silver Creek and 3 miles above mouth of Lively Creek.

Drainage area.—5,220 square miles.

Records available.—January 23, 1907, to December 31, 1912; June 22, 1914, to September 30, 1917. Gage height of river was taken on Wednesday and Thursday mornings from January 23, 1907, to October 28, 1909, by C. J. von Roth Roffy for the New Athens Journal, and by whom they were published. Record authentic. Gage heights have been reduced to the present datum; maximum error probably not more than 0.4 foot, decreasing with increase of stage.

Gage.—Chain gage attached to bridge; read by Henry Hoffman.

Discharge measurements.—Made from downstream side of bridge to which gage is attached or from highway bridge about 500 feet downstream.

Channel and control.—Sand and gravel; may shift.

Extremes of discharge.—Maximum stage recorded during year, 26.1 feet June 14 (discharge, 25,700 second-feet); maximum discharge, 26,100 second-feet, June 13; flow for both these days affected by backwater from Mississippi River; minimum stage recorded, 2.43 feet at noon October 11 (discharge, 142 second-feet).

Maximum stage recorded during periods of records, 35.7 feet August 26, 1915 (discharge, 63,100 second-feet); minimum stage, 2.08 feet August 10, 1914 (discharge, 102-second-feet).

Ice.—Stage-discharge relation affected by ice.

Accuracy.—Stage-discharge relation changed slightly during year; affected by backwater from Mississippi River when height on gage of United States Weather Bureau at Chester, Ill., is above about 14.0 feet, and by ice during parts of winter. Rating curves used during periods of no backwater from the Mississippi fairly well defined. Gage read to hundredths once daily. Daily discharge for periods of no backwater ascertained by applying daily gage height to rating tables; for periods of backwater determined from daily gage heights at New Athens and Chester by slope method described in Water Supply Paper 345, page 53. Records fair for period of backwater effect, poor for periods of ice effect, and good for rest of year.

Discharge measurements of Kaskaskia River at New Athens, Ill., during the year ending Sept. 30, 1917.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
May 17	8.22	a 1,730
July 26	6.52	a 1,120
Sept. 15	4.79	616

a Backwater from Mississippi River when measurement was made. (See "Accuracy" in station description.)

Daily discharge, in second-feet, of Kaskaskia River at New Athens, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	210	287	330	3,050		1,020	2,230	9,540	12,100	1,850	1,270	360
2	185	267	308	2,160		990	4,750	10,200	13,800	1,670	1,270	486
3	210	228	267	1,640		890	6,670	10,500	14,600	1,650	1,110	572
4	219	228	247	1,720		740	7,040	11,000	15,200	1,620	1,270	659
5	185	202	228	7,260	1,100	710	7,320	11,000	15,100	1,530	992	570
6	193	185	228	10,600		680	7,550	10,900	14,000	1,430	753	486
7	185	170	228	12,400		590	6,770	10,500	12,700	1,340	629	433
8	185	170	710	13,000		560	5,380	9,480	12,200	1,270	570	3,150
9	177	170	1,940	13,000		531	5,380	7,770	11,700	1,180	513	4,430
10	170	170	2,210	12,400		503	5,560	4,850	11,600	1,060	570	3,850
11	142	170	2,120	11,100		503	5,200	3,020	14,600	980	1,590	2,600
12	148	170	1,800	10,100		680	4,730	2,370	21,000	905	1,350	1,350
13	148	170	1,280	5,580		2,120	3,670	2,150	26,100	810	920	955
14	148	170	920	3,530		4,550	2,680	2,040	25,700	741	690	753
15	155	177		1,480	375	6,540	2,180	1,990	23,200	680	570	629
16	155	177				8,510	1,820	1,850	20,100	670	486	629
17	148	170				8,130	1,670	1,610	17,400	607	433	570
18	148	162				7,860	1,480	1,450	15,200	574	408	513
19	155	170				6,780	1,330	1,350	13,300	547	360	459
20	170	162	355	1,240		5,860	1,340	1,240	12,000	540	337	384
21	210	162			620	4,730	1,400	1,190	11,000	532	408	360
22	425	162			2,210	4,020	1,380	3,900	10,200	538	337	292
23	400	308			2,450	3,680	1,340	5,980	9,260	593	292	282
24	353	353		2,080	1,900	3,580	1,260	6,700	8,060	593	513	260
25	308	531		2,030	1,280	3,680	1,230	6,940	5,160	1,270	486	250
26	287	620		1,720	1,130	4,070	1,170	6,780	2,790	1,230	513	230
27	247	620	3,050	1,360	1,060	4,070	1,080	5,540	1,960	1,590	753	230
28	219	560	5,440	1,060	990	3,800	2,860	4,100	1,650	2,720	570	211
29	185	450	6,310	1,130		3,360	6,150	4,750	1,430	3,100	513	193
30	185	376	6,940	1,760		2,660	8,090	6,050	1,380	2,210	459	184
31	308		5,030	2,030		2,260		8,300		1,350	384	

NOTE.—Discharge estimated for Dec. 15–26, Jan. 16–23, and Feb. 1–20, because of ice, from gage heights, observer's notes, and weather records. Braced figures show mean discharge for periods indicated. Discharge Mar. 30 to July 28 determined by slope method, because of backwater from Mississippi River. (See "Accuracy" in station description).

Monthly discharge of Kaskaskia River at New Athens, Ill., for the year ending Sept. 30, 1917.

[Drainage area, 5,220 square miles.]

Month.	Discharge in second-feet				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	425	142	212	0.041	0.05
November	620	162	264	.051	.06
December	6,940	....	1,410	.270	.31
January	13,000	....	4,260	.816	.94
February	2,450	....	942	.180	.19
March	8,510	503	3,180	.609	.70
April	8,090	1,080	3,660	.701	.78
May	11,000	1,190	5,650	1.08	1.24
June	26,100	1,380	12,500	2.39	2.67
July	3,100	532	1,210	.232	.27
August	1,590	292	688	.132	.15
September	4,430	184	878	.168	.19
The year	26,100	142	2,900	.556	7.55

BIG MUDDY RIVER AT PLUMFIELD, ILL.

LOCATION.—In W. ½ sec. 20, T. 7 S., R. 2 E., at highway bridge at Plumfield, Franklin County, about 6 miles west of West Frankfort, 11½ miles below mouth of Middle Fork, and 2 miles below station formerly maintained at Chicago, Burlington & Quincy Railroad bridge.

DRAINAGE AREA.—753 square miles.

RECORDS AVAILABLE.—August 18, 1914, to September 30, 1917; June 16, 1908, to September 30, 1912, and November 1, to December 31, 1912, maintained at the Chicago, Burlington & Quincy Railroad bridge.

GAGE.—Chain gage attached to bridge; read by Louis Robertson.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Probably permanent; low-water control is about a quarter of a mile below gage. Point of zero flow is at a stage of about 0.6 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 24.7 feet at 5 p.m. January 8 (discharge, 9,770 second-feet); minimum stage, 0.84 foot at 6 p.m. October 14 (discharge, 3.4 second-feet).

1914–1917: Maximum stage recorded, 30.2 feet February 1, 1916 (discharge, 16,300 second-feet); minimum stage, August 18–26, 1914, when there was no flow past the gage.

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation probably permanent during period of records except as affected by ice during parts of winters. Rating curve fairly-well defined between 43 and 13,500 second-feet. Gage read to hundredths twice daily to May 10, 1917, and once daily afterwards. Daily discharge ascertained by applying daily gage height to rating table. Records good except those for extremely low and high stages, which are fair; poor for periods of ice effect.

Discharge measurements of Big Muddy River at Plumfield, Ill., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 29	G. J. Trinkaus	13.97	2,050	Mar. 29	H. C. Beckman	3.36	169
Jan. 9	H. C. Beckman	24.28	9,310	Sept. 14	.....do	1.77	28.8
16[a]	.....do	11.31	531	14	.....do	1.77	30.3
22[b]	.....do	9.06	1,150				

[a] Ice along shores; probably an ice jam below gage.
[b] Measurement made during rapidly rising stage.

Daily discharge, in second feet, of Big Muddy River at Plumfield, Ill., for the years ending Sept. 30, 1914–1917.

Day.	Aug.	Sept.	Day.	Aug.	Sept.	Day.	Aug.	Sept.
1914.			1914.			1914.		
1		412	11		1,160	21	0.0	50
2		218	12		910	22	.0	29
3		113	13		466	23	.0	24
4		58	14		196	24	.0	25
5		36	15		103	25	.0	17
6		37	16		67	26	.0	29
7		153	17		40	27	4.2	58
8		580	18	0.0	33	28	14	43
9		970	19	.0	76	29	9.0	27
10		1,140	20	.0	85	30	43	18
						31	494	......

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1914-15.												
1	14	9.6	6		2,820	1,730	19	7.0	4,040	2,240	43	3,120
2	12	8.8	6		5,680	955	18	6.2	3,610	2,480	123	2,320
3	10	8.0	6		8,230	425	16	5.2	3,070	2,560	312	1,610
4	8.6	8.0	12		8,830	218	15	4.6	2,280	2,680	264	910
5	7.4	7.4	16	380	8,530	399	15	4.1	1,640	2,720	133	336
6	6.8	7.0	22		7,830	790	14	4.8	895	2,560	85	85
7	5.8	6.2	35		7,110	895	14	9.6	670	2,180	46	50
8	5.0	6.0	123		6,380	730	13	207	336	2,120	28	34
9	108	5.8	108		5,120	466	12	133	207	2,090	20	27
10	580	5.0	76		4,100	312	13	123	123	2,240	19	32
11	1,000	4.8			3,070	229	15	67	85	2,320	36	28
12	1,120	4.5			2,090	174	14	50	80	2,280	252	23
13	1,140	4.5			1,360	133	13	42	207	2,060	399	20
14	1,220	38			925	108	12	32	76	1,480	336	17
15	1,340	27	35	560	730	98	11	22	67	955	625	14
16	1,380	19			580	76	11	18	62	790	1,020	14
17	1,300	15			386	67	11	15	41	640	1,080	13
18	1,160	13			240	62	10	13	39	494	820	153
19	910	8.6			174	58	9.0	11	123	360	820	174
20	508	7.8			133	54	11	14	113	218	1,360	113
21	240	8.0			113	50	10	17	550	128	2,180	43
22	133	8.0			133	46	10	43	1,180	94	3,170	33
23	94	7.4			1,200	46	10	820	1,560	80	5,760	21
24	58	7.4			1,670	42	9.0	1,970	1,880	54	7,830	16
25	40	7.0			2,240	39	8.6	2,640	2,060	33	8,430	12
26	28	7.0	230	290	2,640	35	7.2	2,770	2,000	24	8,030	9.3
27	25	7.0			2,600	30	7.0	2,920	1,440	19	7,370	8.4
28	17	6.6			2,280	28	7.4	3,220	1,030	14	6,470	16
29	14	7.0			......	27	7.0	3,610	1,540	46	5,440	72
30	13	6.8			......	23	6.6	4,110	1,940	118	4,530	123
31	10	......			......	22	......	4,250	......	76	3,670	......

Daily discharge, in second-feet, of Big Muddy River at Plumfield, Ill., for the years ending Sept 30, 1914-1917—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1915–16.												
1	94	4.7	18	2,210	16,000	174	153	31	438	26	7.8	252
2	98	4.4	16	2,820	15,900	174	133	29	438	19	12	103
3	76	4.5	15	3,320	14,700	19'	185	30	1,220	17	7.4	80
4	50	4.7	14	3,550	13,600	218	373	30	1,320	13	9.6	90
5	29	4.8	12	3,490	12,400	386	336	31	1,220	10	14	67
6	22	4.6	10	3,170	11,300	565	240	30	1,300	240	12	58
7	17	4.8	10	2,680	10,100	1,140	163	27	1,640	229	9.6	50
8	14	5.0	11	2,150	8,830	1,440	153	25	1,760	118	8.0	58
9	13	4.8	10	1,400	7,370	1,640	196	30	1,880	67	7.0	610
10	10	4.8	10	985	5,980	1,790	240	31	2,000	38	7.0	865
11	8.2	6.2	163	1,280	4,530	1,580	229	26	2,150	26	6.4	565
12	7.2	43	700	1,970	3,320	985	196	22	2,000	21	6.2	196
13	7.0	31	820		2,640	480	153	19	1,560	153	7.6	85
14	7.8	16	745		2,320	264	118	17	1,040	58	196	46
15	7.2	25	480		2,150	218	94	229	386	174	775	31
16	6.6	22	640	2,150	1,940	207	72	1,120	508	118	1,000	23
17	5.8	17	1,910		1,760	196	58	1,000	595	76	1,100	17
18	5.4	23	2,400		1,610	185	46	775	480	58	1,180	14
19	5.0	103	3,120		1,560	163	39	386	565	128	1,240	11
20	4.8	386	3,370		1,420	153	42	163	508	348	1,460	9.3
21	4.6	252	3,120	1,420	1,000	128	240	128	360	174	1,640	7.8
22	4.4	98	2,600	1,320	625	118	480	153	412	163	1,730	7.0
23	4.3	54	1,760	1,400	466	108	300	118	264	123	1,610	6.2
24	4.2	39	970	1,440	730	103	185	98	324	76	1,100	5.0
25	4.2	35	910	1,400	865	113	143	76	276	42	580	5.0
26	4.2	29	1,100	1,240	760	174	108	80	218	25	252	4.8
27	4.2	25	1,220	1,030	522	466	76	54	153	17	123	4.7
28	4.4	22	1,160	1,460	336	565	58	37	94	14	348	43
29	4.3	21	1,020	2,680	229	425	43	32	58	9.6	715	43
30	4.4	20	1,300	7,640	......	300	37	27	37	7.4	820	67
31	4.6	......	1,640	13,300	......	207	......	276	......	6.4	640	......
1916–17.												
1	76	12	33	2,360		128	805	1,760	1,180	30	805	6.0
2	42	10	29	2,060		143	2,120	2,120	1,610	21	522	113
3	28	8.4	25	1,970		163	3,370	2,440	1,910	14	760	94
4	22	7.0	23	2,090		153	4,250	2,480	2,090	12	700	336
5	17	6.2	50	3,270	410	123	4,880	2,360	2,120	10	324	373
6	14	10	36	6,110		94	4,960	2,120	2,180	9.3	196	196
7	11	16	22	8,730		76	4,670	1,700	2,240	12	118	113
8	8.2	14	240	9,770		85	4,250	1,060	2,180	9.9	80	72
9	6.6	16	670	9,330		80	3,850	480	2,120	8.4	76	373
10	5.4	19	1,140	8,330		76	3,490	218	2,210	7.2	39	452
11	4.8	43	1,320	7,100		67	3,370	153	2,520	6.4	39	360
12	4.4	35	1,300	5,840		163	3,170	118	2,560	5.4	25	143
13	4.0	39	1,080	4,460		895	2,720	90	2,400	4.8	18	62
14	3.5	36	610			1,500	2,150	72	2,180	4.8	15	32
15	4.8	28			25	1,760	1,360	58	1,910	5.2	14	21
16	6.2	24				2,000	715	46	1,240	4.8	46	15
17	5.2	22				2,210	300	39	640	4.7	46	12
18	9.6	20		610		2,180	153	33	185	4.7	29	9.3
19	13	18				1,970	123	27	90	4.3	13	8.4
20	18	17				1,460	108	24	54	4.2	9.0	8.2
21	26	17	120		54	790	90	22	39	5.4	7.0	9.0
22	24	16		1,000	50	730	85	252	30	5.0	7.8	300
23	19	16		1,360	54	895	103	595	24	5.2	14	123
24	20	23		1,540	72	910	76	715	21	4.5	16	41
25	27	24		1,700	118	820	54	480	17	4.3	8.0	23
26	25	94		1,460	143	580	39	288	15	100	42	17
27	22	94		835	128	348	33	143	14	196	37	11
28	20	76	1,540	438	123	229	98	360	13	820	20	8.6
29	16	54	2,030	640	......	163	760	970	31	1,000	14	7.2
30	14	41	2,320	1,180	......	113	1,360	1,160	20	1,080	10	6.0
31	13	......	2,480	1,440	......	85	......	1,020	......	1,040	7.2	......

NOTE.—Discharge estimated for Dec. 11, 1914, to Jan. 31, 1915, Jan. 13-20 and Dec. 15-27, 1916, Jan. 14-21 and Feb. 1-20, 1917, because of ice, from gage heights, observer's notes, and weather records. Braced figures show mean discharge for periods indicated.

Monthly discharge of Big Muddy River at Plumfield, Ill., for the years ending Sept. 30, 1914–1917.

[Drainage area, 753 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1914.					
August 18–31	494	0	40.6	0.054	0.028
September	1,160	17	239	.317	.35
1914–15.					
October	1,380	5.0	403	.535	.62
November	38	4.5	9.54	.013	.01
December	....	6.0	106	.141	.16
January	....	....	406	.539	.62
February	8,830	113	3,110	4.13	4.30
March	1,730	22	270	.359	.41
April	19	6.6	11.6	.015	.02
May	4,250	4.1	876	1.16	1.34
June	4,040	39	1,100	1.46	1.63
July	2,720	14	1,170	1.55	1.79
August	8,430	19	2,280	3.03	3.49
September	3,120	8.4	315	.418	.47
The year	8,830	4.1	825	1.10	14.86
1915–16.					
October	98	4.2	17.3	.023	.03
November	386	4.4	43.8	.058	.06
December	3,370	10	1,010	1.34	1.54
January	13,300	985	2,600	3.45	3.98
February	16,000	229	5,000	6.64	7.16
March	1,790	103	479	.636	.73
April	480	37	163	.216	.24
May	1,120	17	165	.219	.25
June	2,150	37	840	1.12	1.25
July	348	6.4	83.7	.111	.13
August	1,730	6.2	536	.712	.82
September	865	4.7	114	.151	.17
The year	16,000	4.2	905	1.20	16.36
1916–17.					
October	76	3.5	17.1	.023	.03
November	94	6.2	28.5	.038	.04
December	2,480	22	533	.708	.82
January	9.770	....	2,840	3.77	4.35
February	....	....	182	.242	.25
March	2,210	67	677	.899	1.04
April	4,960	33	1,780	2.36	2.63
May	2,480	22	755	1.00	1.15
June	2,560	13	1,130	1.50	1.67
July	1,080	4.2	143	.190	.22
August	805	7.0	131	.174	.20
September	452	6.0	111	.147	.16
The year	9,770	3.5	697	.926	12.56

BIG MUDDY RIVER AT MURPHYSBORO, ILL.

LOCATION.—In SW. ¼ sec. 8, T. 9 S., R. 2 W., at lower highway bridge, South Twentieth Street, about a quarter of a mile below mouth of Louis Creek at Mobile & Ohio Railway bridge.

RECORDS AVAILABLE.—December 6, 1916, to September 30, 1917.

DRAINAGE AREA.—2,170 square miles (measured on map issued by U. S. Geological Survey; scale, 1 to 500,000).

GAGE.—Chain gage attached to bridge; read by G. A. Johnson until May 21 and by E. B. Jacobs afterward.

CHANNEL AND CONTROL.—Heavy clay; may shift.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period of records, 33.3 feet at noon January 10 (discharge, 15,600 second-feet); minimum stage (interpolated), 2.32 feet September 30 (discharge, 29 second-feet).

About February 2, 1916, the river reached a height of 39.6 feet—the highest known stage—on the present gage (discharge, ascertained from extension of rating curve, 28,000 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation changed slightly during high water in January; affected by ice during a period in February, and by backwater from Mississippi River when height on gage of U. S. Weather Bureau at Chester, Ill., is above about 10.0 feet. Rating curves well defined between 435 and 9,000 second-feet, and fairly well defined between 45 and 435 second-feet and between 9,000 and 18,200 second-feet. Gage read to hundredths once daily. Daily discharge during periods of no backwater ascertained by applying daily gage height to rating table; not determined for periods of backwater. Records good except those for very high and low stages, which are fair; poor for period of ice effect.

Discharge measurements of Big Muddy River at Murphysboro, Ill., during the year ending Sept. 30, 1917.

[Made by H. C. Beckman.]

Date	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 6	3.10	146	Jan. 19	14.46	3,480	July 26 [a]	5.32	46
Jan. 10	33.30	15,600	20	10.02	1,670	Sept. 15	3.34	157
15	27.20	10,300	21	6.60	777	15	3.32	148
17	22.30	7,380	Mar. 30 [a]	6.67	495			
18	18.69	5,540	May 17 [a]	8.18	239			

[a] Backwater from Mississippi River when measurement was made.

Daily gage height, in feet, of Big Muddy River at Murphysboro, Ill., for the year ending Sept. 30, 1917.

Day.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		17.2	14.0	3.9	15.6	20.1	19.4	10.6	8.3	5.2
2		15.6	13.3	4.0	20.5	20.6	22.3	11.4	8.2	
3		18.4	12.5	4.0	23.7	21.4	23.0	11.6	8.3	4.4
4		19.8	12.4	4.6		21.6	23.5	11.4	8.5	3.25
5		25.1	9.0	5.1		21.6	23.8	11.2		3.15
6	3.1	26.6	7.0	4.7		20.2	23.4	11.0	6.6	4.9
7	2.9	29.1	5.4	4.3		19.4	21.9	10.8	4.9	6.0
8	6.7	31.7	4.0	4.3		18.4	20.7		4.8	5.4
9	10.5	33.2	4.0	4.6		17.1	20.2	10.0	4.1	
10	13.8	33.3	7.4	4.3		15.0	20.1	9.8	3.8	6.4
11	14.2	32.6	3.25	3.8		13.6	20.0	9.7	3.55	6.5
12	13.7	31.8	3.15	8.2		12.3	20.2	9.5		5.6
13	12.5	30.2	3.05	14.7		11.1	20.8	9.3	3.1	4.9
14	10.5	28.5	3.0	17.9		10.2	21.5	8.7	2.86	3.6
15	8.5	27.1	2.96	18.7		9.8	22.1	9.2	3.1	3.2
16	6.6	24.4	2.80	19.6		8.7	22.2	8.7	3.4	
17	4.7	22.1	2.72	19.5		8.2	21.9	8.1	4.2	2.80
18	4.2	18.6	3.0	19.0		8.3	21.2	7.6	5.3	2.72
19	3.4	14.3	3.05	17.8		7.4	20.1	6.9	3.6	2.70
20	3.5	9.9	3.1	16.3		6.6	19.4	6.3	2.90	2.80
21	3.0	6.6	3.4	14.7		6.2	18.4	6.0	2.84	2.48
22	3.15	8.4	3.55	12.6		7.4	17.5	5.9	2.66	2.36
23	3.2	11.6	3.4	10.1		8.9	16.6	5.8	2.54	3.3
24	3.1	12.3	3.55	11.0		10.3	15.2	5.8	2.52	3.1
25	3.2	12.1	3.55	11.2		9.9	14.4	5.4	2.48	2.90
26	4.4	11.8	3.8	10.4		8.5	13.4	5.3		2.50
27	12.5	11.6	4.0	9.0		7.5	12.4	6.0	2.40	2.42
28	15.7	10.5	4.0	7.4		9.4	11.6	5.6	2.34	2.40
29	18.5	9.6		6.4	14.4	11.5	11.3	7.0	2.36	2.38
30	19.3	11.3		6.4	18.2	12.9	10.5	8.8	2.54	
31	17.2	13.7		6.4		15.9		8.9	4.0	

NOTE.—Stage-discharge relation affected by ice Feb. 6–17 and by backwater from Mississippi River Mar. 16 to Aug. 7.

Daily discharge, in second-feet, of Big Muddy River at Murphysboro, Ill., for the year ending Sept. 30, 1917.

Day.	Dec.	Jan.	Feb.	Mar.	Aug.	Sept.
1	....	4,750	3,250	240	....	475
2	....	3,970	2,940	255	....	398
3	....	5,350	2,600	255	....	321
4	....	6,070	2,560	357	....	142
5	....	9,060	1,370	455	....	128
6	144	9,960		376	....	415
7	118	11,700		304	....	640
8	798	13,900		304	395	515
9	1,820	15,500		357	271	622
10	3,160	15,600		304	225	729
11	3,340	14,800	190	225	188	752
12	3,120	14,000		1,170	154	556
13	2,600	12,600		3,560	120	415
14	1,820	11,200		5,100	87	195
15	1,240	10,300		5,500	120	135
16	775	8,640		....	165	107
17	394	7,340		....	287	79
18	307	5,450	105	....	495	69
19	186	3,380	112	....	195	67
20	200	1,640	120	....	92	45
21	131	775	165	....	84	43
22	151	1,220	188	....	63	32
23	158	2,240	165	....	49	150
24	144	2,520	188	....	47	120
25	158	2,440	188	....	43	92
26	341	2,320	225	....	39	45
27	2,600	2,240	255	....	35	37
28	4,020	1,820	255	....	30	35
29	5,400	1,550	....	....	32	33
30	5,800	2,120	....	....	49	29
31	4,750	3,120	....	....	255	....

NOTE.—Discharge interpolated for Aug. 12 and 26, and Sept. 2, 9, 16, and 30. Discharge Mar. 16 to Aug. 7 not determined owing to backwater from Mississippi River.

Monthly discharge of Big Muddy River at Murphysboro, Ill., for the year ending Sept. 30, 1917.

[Drainage area, 2,170 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum	Minimum.	Mean.	Per square mile.	
Dec. 6-31	5,800	118	1,680	0.774	0.75
January	15,600	775	6,700	3.09	3.56
February	3,250	....	606	.279	.29
Mar. 1-15	5,500	225	1,240	.572	.32
Aug. 8-31	495	30	147	.068	.06
September	752	29	247	.114	.13

FLOOD ON CEDAR RIVER, IOWA, MARCH 23-29, 1917.

The flood on Cedar River in March, 1917, was the highest since that of March, 1906, which exceeded it by about 1 foot. A flood in the fifties exceeded it by about 3 feet. A reconnaissance of the flood situation on Cedar River in the vicinity of Cedar Falls was made March 28, 1917. Information regarding conditions on the main stream was obtained at Cedar Falls, Waterloo, and Cedar Rapids; that concerning Shellrock River was obtained at Shellrock.

The drainage area of Cedar River at Janesville is 1,660 square miles. A few miles below Janesville the Cedar is joined by Shellrock River, whose drainage area comprises 2,690 square miles. Of this area the West Fork, which unites with the Shellrock a few miles above its junction with Cedar River, drains 965 square miles. Beaver River, draining 380 square miles, enters Cedar River between the mouth of Shellrock River and Cedar Falls. The drainage area of Cedar River above Cedar Falls is therefore about 4,730 square miles, and the run-off from 65 per cent of this area is discharged into Cedar River between Janesville and Cedar Falls.

The flood of March, 1917, was due to a small amount of precipitation accompanied by high temperature that caused rapid melting of the snow on the drainage basin. At Charles City, near the eastern border of the drainage basin above Cedar Falls, the temperature rose above freezing March 21, reached 48° March 22, 58° March 23, and 42° March 24. On March 23 there was a rainfall of 0.42 inch.

As nearly as could be determined, the peaks of the March flood on the tributaries entering Cedar River between Janesville and Cedar Rapids occurred at the same time and each was as high as or higher than any that has occurred within the last ten years. The crest of the flood on Cedar River passed Waverly at 3 a. m., Cedar Falls at 8 a. m., and Waterloo about 4 p. m. March 24, Cedar Rapids about 6 p. m. March 26, and Wapello about 3 a. m. March 30.

A current-meter measurement of the flow at Cedar Rapids March 27 at a stage of 15.4 feet on the gage at that place showed a discharge of 44,900 second-feet. The discharge corresponding to the crest of the flood at that place—17.2 feet—was 54,000 second-feet.

The total damage to property from the headwaters of Cedar River to its mouth is estimated at not over $50,000. All streams above Cedar Falls were covered with ice about 24 inches thick until March 22. Small bridges and dams on tributary streams were damaged when the ice broke up, but aside from knocking out a few timbers in the bulkhead of the Nashua dam, the ice did no serious damage at that place. An ice gorge on Cedar River between Nashua and Waverly held the water back for several hours March 23, and when this gorge was dynamited about 9 p. m. March 23, there was a sudden rise of about 3 feet in the stage at the dam at Waverly. There was no damage to property at Waverly, but considerable inconvenience was caused when the power plant had to shut down for a short time. About two-thirds of the apron of the timber dam on Shellrock River at Shellrock was carried out by ice, the damage being about $300. A steel truss bridge at Greene, and three small pile bridges on West Fork, were taken out by the ice. The cost of replacing the steel bridge is estimated at $3,000, and the pile bridges $6,000.

The flood did most damage in the vicinity of Cedar Falls. The total damage to property was estimated by the city engineer at not more than $30,000, exclusive of small losses of private individuals. Of this sum the damage to property which would have to be replaced by the city is estimated at $15,000. One pile bridge of the Illinois Central Railroad was carried out and roadbed washed away in several places, the damage being estimated at $3,000. Damage to the Rock Island Railroad was estimated at $2,500—the cost of replacing a fill about three-fourths of a mile long, between Cedar Falls and Waterloo.

At Waterloo there was no material damage to property, but considerable inconvenience was caused by flooding of basements of residences and business houses. Residents had to move out from six blocks of well-settled residence districts. Flooding of the business district of East Waterloo was prevented by increasing the height of the levee.

There was no damage of consequence to property in Cedar Rapids or below that place.

MISCELLANEOUS MEASUREMENTS.

Miscellaneous discharge measurements in Hudson Bay drainage basin.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
1915.				*Feet.*	*Sec.-ft.*
July 20	Pembina River	Red River	Neche, N. Dak	3.87	24
Sept. 6	.....do	.....do	.....do	2.79	1.9
1916.					
Apr. 24	.....do	.....do	.....do	16.82	a 2,040

a Velocity determined with floats. Coefficient of 0.875 used for reducing measured velocity to mean velocity.

Miscellaneous discharge measurements in Mississippi River drainage basin during the year ending Sept. 30, 1917.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
Oct. 25	West Fork of Chippewa River.	Mississippi River	Sec. 34, T. 40 N., R. 6 W., 1 mile above mouth of East Fork of Chippewa River, Wis.	a 5.56	522
Jan. 6	.....do	.....do	.....do	a 5.38	b 190

a Gage at old gaging station of U. S. Geological Survey.
b Complete ice cover.

INDEX.

STREAM-GAGING STATIONS

AND

PUBLICATIONS RELATING TO WATER RESOURCES

PART V. HUDSON BAY AND UPPER MISSISSIPPI RIVER DRAINAGE BASINS

STREAM-GAGING STATIONS AND PUBLICATIONS RELATING TO WATER RESOURCES.

INTRODUCTION.

Investigation of water resources by the United States Geological Survey has consisted in large part of measurements of the volume of flow of streams and studies of the conditions affecting that flow, but it has comprised also investigation of such closely allied subjects as irrigation, water storage, water powers, underground waters, and quality of waters. Most of the results of these investigations have been published in the series of water-supply papers, but some have appeared in the bulletins, monographs, professional papers, and annual reports.

The results of stream-flow measurements are now published annually in 12 parts, each part covering an area whose boundaries coincide with natural drainage features as indicated below:

Part I. North Atlantic slope basins.
II. South Atlantic slope and eastern Gulf of Mexico basins.
III. Ohio River basin.
IV. St. Lawrence River basin.
V. Upper Mississippi River and Hudson Bay basin.
VI. Missouri River basin.
VII. Lower Mississippi River basin.
VIII. Western Gulf of Mexico basins.
IX. Colorado River basin.
X. Great basin.
XI. Pacific Slope basins in California.
XII. North Pacific slope basins, published in three volumes:
A, Pacific slope basins in Washington and upper Columbia River basin.
B, Snake River basin.
C, Lower Columbia River basin and Pacific slope basins in Oregon.

HOW GOVERNMENT REPORTS MAY BE OBTAINED OR CONSULTED.

Water-supply papers and other publications of the United States Geological Survey containing data in regard to the water resources of the United States may be obtained or consulted as indicated below:

1. Copies may be obtained free of charge by applying to the Director of the Geological Survey, Washington, D. C. The edition printed for free distribution is, however, small and is soon exhausted.
2. Copies may be purchased at nominal cost from the Superintendent of Documents, Government Printing Office, Washington, D. C., who will on application furnish lists giving prices.
3. Sets of the reports may be consulted in the libraries of the principal cities in the United States.

4. Complete sets are available for consultation in the local offices of the water-resources branch of the Geological Survey, as follows:

Boston, Mass., 2500 Customhouse.
Albany, N. Y., 704 Journal Building.
Atlanta, Ga., Post Office Building.
Madison, Wis., care of Railroad Commission of Wisconsin.
Helena, Mont., Montana National Bank Building.
Topeka, Kans., 25 Federal Building.
Austin, Tex., Capitol Building.
Denver, Colo., 403 New Post Office Building.
Salt Lake City, Utah, 421 Federal Building.
Boise, Idaho, 615 Idaho Building.
Portland, Oreg., 606 Post Office Building.
Tacoma, Wash., 406 Federal Building.
San Fancisco, Calif., 328 Customhouse.
Los Angeles, Calif., 619 Federal Building.
Tucson, Ariz., University of Arizona.
Honolulu, Hawaii, 14 Capitol Building.

A list of the Geological Survey's publications may be obtained by applying to the Director of the United States Geological Survey, Washington, D. C.

STREAM-FLOW REPORTS.

Stream-flow records have been obtained at more than 4,240 points in the United States, and the data obtained have been published in the reports tabulated below:

Stream-flow data in reports of the United States Geological Survey.

[A—Annual Report; B—Bulletin; W—Water-Supply Paper.]

Report.	Character of data.	Year.
10th A, pt. 2	Descriptive information only	
11th A, pt. 2	Monthly discharge and descriptive information	1884 to Sept., 1890.
12th A, pt. 2	.....do	1884 to June 30, 1891.
13th A, pt. 3	Mean discharge in second-feet	1884 to Dec. 31, 1892.
14th A, pt. 2	Monthly discharge (long-time records, 1871 to 1893)	1888 to Dec. 31, 1893.
B 131	Descriptions, measurements, gage heights, and ratings	1893 and 1894.
16th A, pt. 2	Descriptive information only	
B 140	Descriptions, measurements, gage heights, ratings, and monthly discharge (also many data covering earlier years).	1895.
W 11	Gage heights (also gage heights for earlier years)	1896.
18th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge (also similar data for some earlier years).	1895 and 1896.
W 15	Descriptions, measurements, and gage heights, eastern United States, eastern Mississippi River, and Missouri River above junction with Kansas.	1897.
W 16	Descriptions, measurements, and gage heights, western Mississippi River below junction of Missouri and Platte, and western United States.	1987.
19th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge (also some long-time records).	1897.
W 27	Measurements, ratings, and gage heights, eastern United States, eastern Mississippi River, and Missouri River.	1898.
W 28	Measurements, ratings, and gage heights, Arkansas River and western United States.	1898.
20th A, pt. 4	Monthly discharge (also for many earlier years)	1898.
W 35 to 39	Descriptions, measurements, gage heights, and ratings	1899.

Stream-flow data in reports of the United States Geological Survey—Continued.

Report.	Character of data.	Year.
21st A, pt. 4	Monthly discharge	1899.
W 47 to 52	Descriptions, measurements, gage heights, and ratings	1900.
22d A, pt. 4	Monthly discharge	1900.
W 65, 66	Descriptions, measurements, gage heights, and ratings	1901.
W 75	Monthly discharge	1901.
W 82 to 85	Complete data	1902.
W 97 to 100	....do	1903.
W 124 to 135	....do	1904.
W 165 to 178	....do	1905.
W 201 to 214	....do	1906.
W 241 to 252	....do	1907-8.
W 261 to 272	....do	1909.
W 281 to 292	....do	1910.
W 301 to 312	....do	1911.
W 321 to 332	....do	1912.
W 351 to 362	....do	1913.
W 381 to 394	....do	1914.
W 401 to 414	....do	1915.
W 431 to 444	....do	1916.
W 451 to 464	....do	1917.

NOTE.—No data regarding stream flow are given in the 15th and 17th annual reports.

The records at most of the stations discussed in these reports extend over a series of years, and miscellaneous measurements at many points other than regular gaging stations have been made each year. An index of the reports containing records obtained prior to 1904 has been published in Water-Supply Paper 119.

The following table gives by years and drainage basins the numbers of the papers on surface-water supply published from 1899 to 1917. The data for any particular station will in general be found in the reports covering the years during which the station was maintained. For example, data for Machias River at Whitneyville, Me., 1903 to 1917, are published in Water-Supply Papers 97, 124, 165, 201, 241, 261, 281, 301, 321, 351, 381, 401, 431, and 451 which contain records for the New England streams from 1903 to 1917. Results of miscellaneous measurements are published by drainage basins.

In these papers and in the following lists the stations are arranged in downstream order. The main stem of any river is determined by measuring or estimating its drainage area—that is, the headwater stream having the largest drainage area is considered the continuation of the main stream, and local changes in name and lake surface are disregarded. All stations from the source to the mouth of the main stem of the river are presented first, and the tributaries in regular order from source to mouth follow, the streams in each tributary basin being listed before those of the next basin below.

In exception to this rule the records for Mississippi River are given in four parts, as indicated on page III, and the records for large lakes are taken up in order of streams around the rim of the lake.

Numbers of water-supply papers containing results of stream measurements, 1899–1917.[a]

Year.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII		
												North Pacific drainage basins.		
	North Atlantic slope basin (St. John River to York River).	South Atlantic slope and eastern Gulf of Mexico basin (James River to the Mississippi).	Ohio River basin.	St. Lawrence River and Great Lakes basins.	Hudson Bay and upper Mississippi River basins.	Missouri River basin.	Lower Mississippi River basin.	Western Gulf of Mexico basins.	Colorado River basin.	Great Basin.	Pacific slope basins in California.	Pacific slope basins in Washington and upper Columbia River basin.	Snake River basin.	Lower Columbia River basin and Pacific slope basins in Oregon.
1899[a]	35	*b* 35, 36	36	36	36	*c* 36, 37	37	37	*d* 37, 38	38, *e* 39	38, *f* 39	38	38	38
1900[g]	47, *h* 48	48	48, *i* 49	49	49	49, *j* 50	50	50	50	51	51	51	51	51
1901	65, 75	65, 75	65, 75	65, 75	*k* 65, 66, 75	66, 75	*k* 65, 66, 75	66, 75	66, 75	66, 75	66, 75	66, 75	66, 75	66, 75
1902	82	*b* 82, 83	83	*l* 82, 83	*k* 83, 85	84	*k* 83, 84	84	85	85	85	85	85	85
1903	97	*b* 97, 98	98	97	*k* 98, 99, *m* 100	99	*k* 98, 99	99	100	100	100	100	100	100
1904	*n* 124, *o* 125, *p* 126	*p* 126, 127	128	129	*k* 128, 130	130, *q* 131	*k* 128, 131	132	133	133, *r* 134	134	135	135	135
1905	*n* 165, *o* 166, *p* 167	*p* 167, 168	169	170	171	172	*k* 169, 173	174	175, *s* 177	176, *r* 177	177	178	178	*t* 177, 178
1906	*n* 201, *o* 202, *p* 203	*p* 203, 204	205	206	207	208	*k* 205, 209	210	211	212, *r* 213	213	214	214	214
1907–8	241	242	243	244	245	246	247	248	249	250, *r* 251	251	252	252	252
1909	261	262	263	264	265	266	267	268	269	270, *r* 271	271	272	272	272
1910	281	282	283	284	285	286	287	288	289	290	291	292	292	292
1911	301	302	303	304	305	306	307	308	309	310	311	312	312	312
1912	321	322	323	324	325	326	327	328	329	330	331	332A	332B	332C
1913	351	352	353	354	355	356	357	358	359	360	361	362A	362B	362C
1914	381	382	383	384	385	386	387	388	389	390	391	392	393	394
1915	401	402	403	404	405	406	407	408	409	410	411	412	413	414
1916	431	432	433	434	435	436	437	438	439	440	441	442	443	444
1917	451	452	453	454	455	456	457	458	459	460	461	462	463	464

a Rating tables and index to Water-Supply Papers 35–39 contained in Water-Supply Paper 39. Tables of monthly discharge for 1899 in Twenty-first Annual Report, Part IV.
b James River only.
c Gallatin River.
d Green and Gunnison rivers and Grand River above junction with Gunnison.
e Mohave River only.
f Kings and Kern rivers and south Pacific slope drainage basins.
g Rating tables and index to Water-Supply Papers 47–52 and data on precipitation, wells, and irrigation in California and Utah contained in Water-Supply Paper 52. Tables of monthly discharge for 1900 in Twenty-second Annual Report, Part IV.
h Wissahickon and Schuylkill rivers to James River.
i Scioto River.
j Loup and Platte rivers near Columbus, Nebr., and all tributaries below junction with Platte.
k Tributaries of Mississippi from east.
l Lake Ontario and tributaries to St. Lawrence River proper.
m Hudson Bay only.
n New England Rivers only.
o Hudson River to Delaware River, inclusive.
p Susquehanna River to Yadkin River, inclusive.
q Platte and Kansas rivers.
r Great Basin in California except Truckee and Carson river basins.
s Below junction with Gila.
t Rogue, Umpqua, and Siletz rivers only.

PART V.—HUDSON BAY AND UPPER MISSISSIPPI RIVER DRAINAGE BASINS.

PRINCIPAL STREAMS.

The Hudson Bay and upper Mississippi River basins include streams whose waters reach Hudson Bay and the Mississippi above its junction with the Ohio (except the Missouri). The principal streams flowing into Hudson Bay from the United States are St. Mary River, Red River, and Rainy River. The principal tributaries of the upper Mississippi are Crow Wing, Sauk, Crow, Rum, Minnesota, St. Croix, Chippewa, Zumbro, Black, Root, Wisconsin, Wapsipinicon, Rock, Iowa, Des Moines, Illinois, and Kaskaskia rivers. These streams drain wholly or in part the States of Illinois, Indiana, Iowa, Minnesota, Missouri, Montana, North Dakota, South Dakota, and Wisconsin.

In addition to the list of gaging stations and the annotated list of publications relating specifically to the section, these pages contain a similar list of reports that are of general interest in many sections and cover a wide range of hydrologic subjects, and also brief references to reports published by State and other organizations. (See p. xvii.)

GAGING STATIONS.

NOTE.—Dash after a date indicates that station was being maintained September 30, 1917. Period after a date indicates dicontinuance.

HUDSON BAY DRAINAGE BASIN.

St. Mary River near Babb (formerly dam site), Mont., 1902–
St. Mary River below Swiftcurrent Creek, at Babb, Mont., 1901–2; 1910–1915.
St. Mary River near Kimball, Alberta, 1902–
  Swiftcurrent Creek at Many Glacier, Mont., 1912–
  Swiftcurrent Creek at Sherburne, Mont., 1912–
  Swiftcurrent Creek near Babb (formerly Wetzel) Mont., 1902–1910.
  U. S. Reclamation Service, St. Mary canal at Hudson Bay divide near Browning, Mont., 1917–
  Kennedy Creek near Babb (formerly Wetzel), Mont., 1903–1907.
Ottertail River at German Church, near Fergus Falls, Minn., 1913–1917.
Ottertail River near Fergus Falls, Minn., 1904–1913.
Red River near Fergus Falls, Minn., 1909–10.
Red River at Fargo, N. Dak., 1901–
Red River at Grand Forks, N. Dak., 1901–
Red River at Pembina, N. Dak., 1901.
Red River at Emerson, Manitoba, 1900–1902.
  Mustinka River near Wheaton, Minn., 1916; 1917.
  Pelican River near Fergus Falls, Minn., 1909–1912.
  Sheyenne River at Haggart, N. Dak., 1902–1907.
  Wild Rice River at Twin Valley, Minn., 1909–1917.
    Devils Lake near Devils Lake, N. Dak., 1901–
  Red Lake River at Thief River Falls, Minn., 1909–

Red River tributaries—Continued.
- Red Lake River at Crookston, Minn., 1901–
  - Thief River near Thief River Falls, Minn., 1909–1917.
  - Clearwater River at Red Lake Falls, Minn., 1909–1917.
  - South Branch of Two Rivers at Hallock, Minn., 1911–1914.
- Pembina River at Necho, N. Dak., 1903–1915.
  - Roseau River at Dominion City, Canada, 1912.
  - Roseau River near Caribou, Minn., 1917.
    - West Branch of Roseau River near Malung, Minn., 1911–1914.
- Mouse River near Foxholm, N. Dak., 1904–1906.
- Mouse River at Minot, N. Dak., 1903–
  - Des Lacs River at Foxholm, N. Dak., 1904–1906.
- Rainy Lake at Rainier, Minn., 1910–1917.
- Rainy River at International Falls, Minn., 1907–1917.
- Kawishiwi River near Winton, Minn., 1905–1907; 1912–
  - Vermilion River below Lake Vermilion, near Tower, Minn., 1911–1917.
  - Little Fork at Little Fork, Minn., 1909–1917.
  - Big Fork at Big Falls, Minn., 1909–1912.
  - Big Fork at Laurel, Minn., 1909.
  - Black River near Loman, Minn., 1909.

UPPER MISSISSIPPI RIVER BASIN.

Mississippi River above Sandy River, Minn., 1895–1915.
Mississippi River near Fort Ripley, Minn., 1909–10.
Mississippi River near Sauk Rapids, Minn., 1903–1906.
Mississippi River at Elk River, Minn., 1915–
Mississippi River at Anoka, Minn., 1905–1914.
Mississippi River at St. Paul, Minn., 1873–
- Sandy River below Sandy Lake reservoir, Minn., 1893–1916.
- Pine River below Pine River reservoir, Minn., 1886–1916.
- Prairie River near Grand Rapids, Minn., 1909.
- Crow Wing River at Nimrod, Minn., 1910–1914.
- Crow Wing River at Motley, Minn., 1909; 1913–1917.
- Crow Wing River at Pillager, Minn., 1903; 1909–1913.
- Long Prairie River near Motley, Minn., 1909–1917.
- Sauk River near St. Cloud, Minn., 1909–1913.
- Elk River near Big Lake, Minn., 1911–1917.
- Crow River at Rockford, Minn., 1909–1917.
- Crow River near Dayton, Minn., 1906.
  - North Fork of Crow River near Rockford, Minn., 1909–10.
  - South Fork of Crow River near Rockford, Minn., 1909–1912.
- Rum River at Onamia, Minn., 1909–1912.
- Rum River at Cambridge, Minn., 1909–1914.
- Rum River at St. Francis, Minn., 1903.
- Rum River near Anoka, Minn., 1905–6; 1909.
- Minnesota River near Odessa, Minn., 1909–1913.
- Minnesota River near Montevideo, Minn., 1909–
- Minnesota River near Mankato, Minn., 1903–
  - Whetstone River near Big Stone, S. Dak., 1910–1912.
  - Lac qui Parle River at Lac qui Parle, Minn., 1910–1914.
  - Chippewa River near Watson, Minn., 1909–1917.
  - Redwood River near Redwood Falls, Minn., 1909–1914.
  - Cottonwood River near New Ulm, Minn., 1909–1913.
  - Blue Earth River, at Rapidan Mills, Minn., 1909–10.

Mississippi River tributaries—Continued.
- St. Croix River at Swiss, Wis., 1914–
- St. Croix River near St. Croix Falls, Wis., 1902–1905; 1910–
  - Namakagon River at Trego, Wis., 1914–
  - Yellow River at Webster, Wis., 1914.
  - Kettle River near Sandstone, Minn., 1908–1916.
  - Snake River at Mora, Minn., 1909–1913.
  - Snake River near Pine City, Minn., 1913–1917.
  - Apple River near Somerset, Wis., 1901–
  - Kinnikinnic River near River Falls, Wis., 1916–
- Cannon River at Welch, Minn., 1909–1914.
- Chippewa River at Bishops Bridge, near Winter, Wis., 1912–
- Chippewa River near Bruce, Wis., 1913–
- Chippewa River at Chippewa Falls, Wis., 1888–
- Chippewa River near Eau Claire, Wis., 1902–1909.
  - West Fork of Chippewa River near Winter, Wis., 1911–1916.
  - Flambeau River near Butternut, Wis., 1914–
  - Flambeau River near Ladysmith, Wis., 1914–
  - Flambeau River at Ladysmith, Wis., 1903–1906.
  - Jump River at Sheldon, Wis., 1915–
  - Eau Claire River near Augusta, Wis., 1914–
  - Eau Claire River near Eau Claire, Wis., 1913–14.
  - Red Cedar River near Colfax, Wis., 1914–
  - Red Cedar River at Cedar Falls, Wis., 1909–
  - Red Cedar River at Menominee, Wis., 1907–8; 1913–
- Zumbro River at Zumbro Falls, Minn., 1909–1917.
  - South Branch of Zumbro River near Zumbro Falls, Minn., 1911–1917.
- Trempealeau River at Dodge, Wis., 1913–
- Black River at Neillsville, Wis., 1905–1909; 1913–
- Black River at Melrose, Wis., 1902–3.
- La Crosse River near West Salem, Wis., 1913–
- Root River near Houston, Minn., 1909–1917.
  - North Branch of Root River near Lanesboro, Minn., 1910–1917.
- Upper Iowa River near Decorah, Iowa, 1913–14.
- Wisconsin River near Rhinelander, Wis., 1905–1915.
- Wisconsin River at Whirlpool Rapids, near Rhinelander, Wis., 1915–
- Wisconsin River at Merrill, Wis., 1902–
- Wisconsin River near Nekoosa, Wis., 1914–
- Wisconsin River near Necedah, Wis., 1902–1914.
- Wisconsin River at Muscoda, Wis., 1902–3; 1913–
  - Tomahawk River near Bradley, Wis., 1914–
  - Prairie River near Merrill, Wis., 1914–
  - Little Rib River near Wausau, Wis., 1914–1916.
  - Eau Claire River at Kelley, Wis., 1914–
  - Big Eau Pleine River near Stratford, Wis., 1914–
  - Plover River near Stevens Point, Wis., 1914–
  - Baraboo River near Baraboo, Wis., 1913–
  - Kickapoo River at Gays Mills, Wis., 1913–
- Turkey River at Garber, Iowa, 1913–1916.
- Maquoketa River above mouth of North Fork, near Maquoketa, Iowa, 1913–14.
- Maquoketa River at Manchester, Iowa, 1903.
- Maquoketa River below mouth of North Fork, near Maquoketa, Iowa, 1913–
- Wapsipinicon River at Stone City, Iowa, 1903–1914.
- Rock River at Watertown, Wis., 1914.

Mississippi River tributaries—Continued.
- Rock River at Afton, Wis., 1914–
- Rock River above mouth of Pecatonica River, at Rockton, Ill., 1903.
- Rock River below mouth of Pecatonica River, at Rockton, Ill., 1903–1909.
- Rock River at Rockford, Ill., 1914–
- Rock River near Nelson, Ill., 1906.
- Rock River at Sterling, Ill., 1905–6.
- Rock River at Lyndon, Ill., 1914–
  - Catfish River at Madison, Wis., 1902–3.
  - Lake Mendota at Madison, Wis., 1902–3.
  - Yahara River near Edgerton, Wis., 1916–17.
  - Pecatonica River at Dill, Wis., 1914–
  - Pecatonica River at Freeport, Ill., 1914–
    - Sugar River near Brodhead, Wis., 1914–
- Iowa River near Iowa Falls, Iowa, 1911–1914.
- Iowa River at Marshalltown, Iowa, 1903; 1915–
- Iowa River at Iowa City, Iowa, 1903–1906; 1913–
- Iowa River at Wapello, Iowa, 1915–
  - Cedar River near Austin, Minn., 1909–1914.
  - Cedar River at Janesville, Iowa, 1905–6; 1915–
  - Cedar River at Cedar Rapids, Iowa, 1902–
    - Shellrock River near Clarksville, Iowa, 1915–
- Skunk River at Coppock, Iowa, 1913–
- Skunk River at Augusta, Iowa, 1913; 1915–
- Des Moines River at Jackson, Minn., 1909–1913.
- Des Moines River at Fort Dodge, Iowa, 1905–6; 1911–1913.
- Des Moines River at Kalo, Iowa, 1913–
- Des Moines River at Des Moines, Iowa, 1902–3; 1905–6; 1914–
- Des Moines River at Ottumwa, Iowa, 1917–
- Des Moines River at Keosauqua, Iowa, 1903–1906; 1911–
  - Raccoon River near Des Moines, Iowa, 1902–3.
  - Raccoon River at Van Meter, Iowa, 1915–
- Illinois River near Minooka, Ill., 1902–1904.
- Illinois River near Seneca, Ill., 1902–3.
- Illinois River near Ottawa, Ill., 1902–1904.
- Illinois River near La Salle, Ill., 1902–3.
- Illinois River at Peoria, Ill., 1910–
- Illinois River near Peoria, Ill., 1903–1906.
  - Kankakee River at Davis, Ind., 1905–6.
  - Kankakee River at Momence, Ill., 1905–6; 1914–
  - Kankakee River at Custer Park, Ill., 1914–
    - Yellow River at Knox, Ind., 1905–6.
  - Des Plaines River at Riverside, Ill., 1896–1898.
  - Des Plaines River above mouth of Jackson Creek, near Channahon, Ill., 1903–1906.
  - Des Plaines River above Kankakee River, near Channahon, Ill., 1902–3.
  - Des Plaines River at Lemont, Ill., 1914–
  - Des Plaines River at Romeo, Ill., 1914.
  - Des Plaines River at Joliet, Ill., 1914–
  - Fox River at Algonquin, Ill., 1915–
  - Fox River at South Elgin, Ill., 1914–15.
  - Fox River at Aurora, Ill., 1914.
  - Fox River at Sheridan, Ill., 1905–6.
  - Fox River at Wedron, Ill., 1914–

Mississippi River tributaries—Continued.
- Illinois River tributaries—Continued.
  - Fox River at Ottawa, Ill., 1903.
  - Vermilion River near Streator, Ill., 1914–
  - Spoon River at Seville, Ill., 1914–
  - Sangamon River at Monticello, Ill., 1908–1912; 1914–
  - Sangamon River at Decatur, Ill., 1905.
  - Sangamon River at Riverton, Ill., 1908–1912; 1914–
  - Sangamon River at Springfield, Ill., 1903.
  - Sangamon River near Oakford, Ill., 1909–1912; 1914–
  - Sangamon River near Chandlerville, Ill., 1908–9.
    - South Fork of Sangamon River near Taylorville, Ill., 1908–1912; 1914–1917.
    - South Fork Sangamon River at power plant near Taylorville, Ill., 1917–
    - Salt Creek near Kenny, Ill., 1908–1912.
- Cahokia Creek at Poag, Ill., 1909–1912.
- Kaskaskia River near Arcola, Ill., 1908–1912.
- Kaskaskia River at Shelbyville, Ill., 1908–1912; 1914.
- Kaskaskia River at Vandalia, Ill., 1908–1912; 1914–
- Kaskaskia River at Carlyle, Ill., 1908–1912; 1914–15.
- Kaskaskia River at New Athens, Ill., 1907–1912; 1914–
  - Shoal Creek near Breese, Ill., 1909–1912; 1914.
  - Silver Creek near Lebanon, Ill., 1908–1912; 1914.
- Big Muddy River near Cambon, Ill., 1908–1912.
- Big Muddy River at Plumfield, Ill., 1914–
- Big Muddy River at Murphysboro, Ill., 1917–
  - Beaucoup Creek near Pinckneyville, Ill., 1908–1912; 1914.

REPORTS ON WATER RESOURCES OF THE HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS.

PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY.

WATER-SUPPLY PAPERS.

Water-supply papers are distributed free by the Geological Survey as long as its stock lasts. An asterisk (*) indicates that this stock has been exhausted. Many of the papers marked in this way may, however, be purchased (at prices quoted) from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C. Omission of the price indicates that the report is not obtainable from Government sources. Water-supply papers are of octavo size.

*21. Wells of northern Indiana, by Frank Leverett. 1899. 82 pp., 2 pls.

Discusses, by counties, glacial deposits and sources of well waters; many well sections.

*44. Profiles of rivers in the United States, by Henry Gannett. 1901. 100 pp., 11 pls. 15c.

Gives elevations and distances along Red River (of the North), and Minnesota, Skunk, Iowa, Des Moines, Illinois, and Rock rivers; also brief descriptions.

*57. Preliminary list of deep borings in the United States, Part I (Alabama-Montana), by N. H. Darton. 1902. 60 pp. 5c.

*61. Preliminary list of deep borings in the United States, Part II (Nebraska-Wyoming), by N. H. Darton. 1902. 67 pp. 5c.

A revised edition of Nos. 57 and 61 was published in 1905 as Water-Supply Paper 149 (q. v.).

96. Destructive floods in the United States in 1903, by E. C. Murphy. 1904. 81 pp., 13 pls. 15c.

Contains notes on early floods in Mississippi Valley.

102. Contributions to the hydrology of eastern United States, 1903; M. L. Fuller, geologist in charge. 1904. 522 pp. 30c.

Contains brief reports on wells and springs of Minnesota and Missouri.

The reports comprise tabulated well records giving information as to location, owner, depth, yield, head, etc., supplemented by notes as to elevation above sea, material penetrated, temperature, use, and quality; many miscellaneous analyses.

*103. A review of the laws forbidding pollution of inland waters in the United States, by E. B. Goodell. 1904. 120 pp.

Cites statutory restrictions of water pollution in Iowa, Illinois, North Dakota, South Dakota, and Wisconsin. Superseded by 152.

*114. Underground waters of eastern United States; M. L. Fuller, geologist in charge. 1905. 285 pp., 18 pls. 25c.

Contains brief reports as follows: Missouri, by E. M. Shepard; Iowa, by W. H. Norton; Minnesota, by C. W. Hall; Wisconsin district, by Alfred R. Schultz; Illinois, by Frank Leverett; Indiana, by Frank Leverett; each of these reports describes briefly the topography of the area, the relation of the geology to the water supplies, and gives list of pertinent publications; lists also principal mineral springs.

117. The lignite of North Dakota and its relation to irrigation, by F. A. Wilder. 1905. 59 pp., 8 pls. 10c.

Describes the thickness, extent, variations, and fuel value of the lignite and its use for pumping water, the area, soils, and lignite of the river flats, and the st.tus of irrigation in the State.

*122. Relation of the law to underground waters, by D. W. Johnson. 1905. 55 pp. 5c.

Cites legislative acts affecting underground waters in South Dakota and Wisconsin.

145. Contributions to the hydrology of eastern United States, 1905; M. L. Fuller, geologist in charge. 1905. 220 pp., 6 pls. 10c.

Contains two reports relating to areas draining to Hudson Bay or upper Mississippi River.

Water resources of Mineral Point quadrangle, Wisconsin, by U. S. Grant. Describes springs, streams, and shallow and deep wells.

Water supplies at Waterloo, Iowa, by W. H. Norton. Summarizes results of investigations to determine availability of artesian water to replace the surface supply from Cedar River; discusses necessity of test wells, supplementary supplies, artesian head, and permanency of flow.

*149. Preliminary list of deep borings in the United States, second edition, with additions, by N. H. Darton. 1905. 175 pp. 10c.

Gives by States (and within the States by counties), the location, depth, diameter, yield height of water, and other features of wells 400 feet or more in depth; includes all wells listed in Water-Supply Papers 57 and 61; mentions also principal publications relating to deep borings.

*152. A review of the laws forbidding pollution of the inland waters in the United States (second edition), by E. B. Goodell. 1905. 149 pp. 10c.

Cities statutory restrictions of water pollution in Iowa, Illinois, North Dakota, South Dakota, and Wisconsin.

*156. Water powers of northern Wisconsin, by L. S. Smith. 1906. 145 pp., 5 pls. 25c.

Describes by river systems the drainage, geology, topography, rainfall and run-off, water powers, and dams.

*162. Destructive floods in the United States in 1905, with a discussion of flood discharge and frequency and an index of flood literature, by E. C. Murphy and others. 1906. 105 pp., 4 pls. 15c.

Contains accounts of floods in southeastern Minnesota, on Devils Creek, Iowa, and in Des Moines County, Iowa; gives estimates of flood discharge and frequency on Illinois River and on Mississippi River at St. Paul.

*193. The quality of surface waters in Minnesota, by R. B. Dole and F. F. Westbrook. 1907. 171 pp., 7 pls. 25c.

Describes by river basins the topography, geology, and soils, the individual and municipal pollution of the streams, and gives notes on the municipalities; contains many analyses.

*194. Pollution of Illinois and Mississippi Rivers by Chicago sewage (a digest of the testimony taken in the case of the State of Missouri *v.* the State of Illinois and the Sanitary District of Chicago), by M. O. Leighton. 1907. 369 pp., 2 pls.

Scope indicated by amplification of title.

*195. Underground waters of Missouri, their geology and utilization, by E. M. Shepard. 1907. 224 pp., 6 pls. 30c.

Describes the topography and geology of the State, the waters of the various formations, and discusses the water supplies by districts and counties, gives statistics of city water supplies, analyses of waters, and many well records.

*227. Geology and underground waters of South Dakota, by N. H. Darton. 1909. 156 pp., 15 pls. 40c.

Describes physical features, geologic formations, water horizons, and, by counties, deep wells and well prospects; gives notes on construction and management of artesian wells.

236. The quality of surface waters in the United States: Part I, Analyses of waters east of the one hundredth meridian, by R. B. Dole. 1909. 123 pp. 10c.

Describes collection of samples, methods of examination, preparation of solutions, accuracy of estimates and expression of analytical results; gives results of analyses of waters of Mississippi, Minnesota, Chippewa, Wisconsin, Rock, Iowa, Cedar, Des Moines, Illinois, Kankakee, Fox, Sangamon, Kaskakia, and Big Muddy rivers.

239. The quality of the surface waters of Illinois, by W. D. Collins. 1910. 94 pp., 3 pls. 10c.

Discusses the natural and economic features that determine the character of the streams, describes the larger drainage basins, and the methods of collecting and analyzing the samples of water, and discusses each river in detail with reference to its source and course and the quality of water; includes short chapters on municipal supplies and industrial uses.

254. The underground waters of north-central Indiana, by S. R. Capps, with a chapter on the chemical character of the waters, by R. B. Dole. 1910. 279 pp., 7 pls. 40c.

Describes relief, drainage, vegetation, soils, and crops, industrial development, geologic formations; sources, movements, occurence, and volume of ground water; methods of well construction and lifting devices; discusses, in detail for each county, surface features and drainage, geology and ground water, city, village, and rural supplies, and gives records of wells and analyses of waters. Discusses also, under chemical character, methods of analyses and expression of results, mineral constituents, effect of the constituents on waters for domestic, industrial, and medicinal uses, methods of purification, chemical composition; many analyses and field assays.

256. Geology and underground waters of southern Minnesota, by C. W. Hall, O. E. Meinzer, and M. L. Fuller. 1911. 406 pp., 18 pls. 60c

Discusses the physiography of the State, geologic formations and their water-bearing capacity, artesian conditions, the mineral quality of the underground waters, types of wells, finishing wells in sand, drilling in quarzite, fluctuation in yield and head, "blowing" and "breathing" wells, freezing of wells, drainage by wells, hydraulic rams, and scientific prospecting for water, municipal supplies, power, storage and distribution, consumption of water, prices, sanitation. Gives by counties details concerning surface features, rocks, yield, head, and quality of water, and summaries and analyses.

293. Underground water resources of Iowa, by W. H. Norton, W. S. Hendrixson, H. E. Simpson, O. E. Meinzer, and others. 1912. 994 pp., 18 pls. 70c.

Describes the relief, drainage, temperature, and precipitation of the State and the geologic formations; discusses the geologic occurrence of ground waters, artesian phenomena and yield of artesian wells, the chemical composition of ground waters, municipal, domestic, and industrial water supplies, and mineral waters; gives details concerning topography, geology, ground waters, and city and village supplies by districts and counties.

*345. Contributions to the hydrology of the United States, 1914. N. C. Grover, chief hydraulic engineer. 1915. 225 pp., 17 pls. 30c. Contains:

(f) Gazetteer of surface waters of Iowa, by W. G. Hoyt and H. J. Ryan, pp. 169-221.

364. Water analyses from the laboratory of the United States Geological Survey, tabulated by F. W. Clarke, chief chemist. 1914. 40 pp. 5c.

Contains analyses of spring and well waters from Nashville and Macomb, Ill., and Story City, Iowa.

417. Profile surveys of rivers in Wisconsin, prepared under the direction of W. H. Herron, acting chief geographer. 1917. 16 pp., 32 pls. 45c.

Contains brief description of general features of drainage of Wisconsin and of the rivers surveyed, but consists chiefly of maps showing "not only the outlines of the river banks, the islands, the position of rapids, falls, shoals, and existing dams, and the crossings of all ferries and roads, but the contours of banks to an elevation high enough to indicate the possibilitiey of using the stream" for the development of power by low or medium heads.

ANNUAL REPORTS.

Each of the papers contained in the annual reports was also issued in separate form.

Annual reports are distributed free by the Geological Survey as long as its stocks lasts. An asterisk (*) indicates that this stock has been exhausted. Many of the papers so marked, however, may be purchased, from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C.

*Sixteenth Annual Report of the United States Geological Survey, 1894–95. 4 parts.

*Pt. II. Papers of an economic character, XIX, 598 pp., 43 pls. $1.25. Contains:

The public lands and their water supply, by F. H. Newell, pp. 457-533, pls. 35 to 39. Describes general character of the public lands, the lands disposed of (railroad, grant, and swamp lands, and private miscellaneous entries), lands reserved (Indian, forest, and military reservations), the vacant lands, and the rate of disposal of vacant lands; discusses the streams, wells, and reservoirs as sources of water supply; gives details for each State.

Seventeenth Annual Report of the United States Geological Survey, 1895–96, Charles D. Walcott, Director, 1896; 3 parts in 4 vols. *Pt. II. Economic geology and hydrography, xxv, 864 pp., 113 pls. $2.35. Contains:

Preliminary report on artesian waters of a portion of the Dakotas, by N. H. Darton, pp. 603–694, pls. 69 to 107. Gives an outline of the geologic relations; describes the water horizons and the extent of the artesian water, and gives details concerning wells and prospects by counties; discusses the origin, amount, pressure, head, and composition of the artesian waters, the use of artesian water for power, and gives details concerning artesian irrigation by counties; contains also remarks on the construction and management of artesian wells.

*The water resources of Illinois, by Frank Leverett, pp. 695–849, pls. 108 to 113. Describes the physical features of the State, and the drainage basins, including Illinois, Des Plaines, Kankakee, Fox, Illinois-Vermilion, Spoon, Mackinaw, and Sangamon rivers, Macoupin Creek, Rock River, tributaries of the Mississippi in western Illinois, Kaskaskia, Big Muddy, and tributaries of the Wabash; discusses the rainfall and run-off, navigable waters and water powers, the wells supplying waters for rural districts, and artesian wells; contains tabulated artesian well data and water analyses.

Eighteenth Annual Report of the United States Geological Survey, 1896–97, 5 parts in 6 vols. *Pt. IV, Hydrography, x, 756 pp., 102 pls. $1.75. Contains:

*The water resources of Indiana and Ohio, by Frank Leverett, pp. 419–560, pls. 33 to 37. Describes the Wabash, Whitewater, Great Miami, Little Miami, Scioto, Hocking, Muskingum, and Beavers rivers, and lesser tributaries of the Ohio in Indiana and Ohio, the streams discharging into Lake Erie and Lake Michigan, and streams flowing to the upper Mississippi through the Illinois; discusses shallow and drift wells, the flowing wells, from the drift and deeper artesian wells, and gives records of wells at many of the cities; describes the mineral springs, and gives analyses of the waters; contains also tabulated lists of cities using surface waters for water works, and of cities and villages using shallow and deep-well waters; discusses the source and quality of the city and village supplies, and gives precipitation tables for various points.

MONOGRAPHS.

Monographs of quarto size. They are not distributed free, but may be obtained from the Geological Survey or from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C., at the prices indicated. An asterisk (*) indicates that the Survey's stock of the paper is exhausted.

25. The glacial Lake Agassiz, by Warren Upham. 1896. 658 pp., 38 pls. $1.70.

Contains a chapter (pp. 523–582) on "Artesian and common wells of the Red River Valley," which discusses the sources of artesian water, the fresh waters in the drift sheets, the saline and alkaline waters in the Dakota sandstone, and the use of artesian water for irrigation; contains analyses of waters from wells, streams, and lakes in Red River Valley and the adjoining region; and gives notes on wells in Clay, Kittson, Marshall, Norman, Polk, Traverse, and Wilkin counties, in Minnesota; in Cass, Grand Forks, Pembina, Richland, Traill, and Walsh counties, in North Dakota; and in a part of the area covered by Lake Agassiz, in Manitoba. The monograph includes numerous maps relating to the Pleistocene geology of the region and a map (Pl. XXXVII) showing the distribution and depths of artesian wells in glacial drift and bedrock.

38. The Illinois glacial lobe, by Frank Leverett. 1899. 817 pp., 24 pls. $1.60.

Includes a chapter (pp. 550-788) on "Wells of Illinois," which contains a general discussion of artesian and other wells, a table of municipal water supplies derived from underground sources, and a detailed description of wells and ground-water conditions in practically every county in the State. The monograph includes maps showing the geology, the distribution of wells, the intake areas of "Potsdam" and St. Peter sandstones, and the relation of glacial drift to ground-water supplies.

PROFESSIONAL PAPERS.

Professional papers are distributed free by the Geological Survey as long as its stock lasts. An asterisk (*) indicates that this stock has been exhausted. Many of the papers marked with an asterisk may, however, be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C. Professional papers are of quarto size.

*32. Preliminary report on the geology and underground-water resources of the central Great Plains, by N. H. Darton. 1905. 433 pp., 72 pls. $1.80.

Covers South Dakota, Nebraska, central and western Kansas, eastern Colorado, and eastern Wyoming. Describes the geography, geology, and water horizons; gives deep-well data and well prospects by counties; also describes other mineral resources. Includes maps showing the geology, location of deep wells, structure of the Dakota sandstone, depths to this sandstone head of artesian water, and areas of artesian flow.

BULLETINS.

An asterisk (*) indicates that the Geological Survey's stock of the paper is exhausted. Many of the papers so marked may be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C.

*264. Record of deep-well drilling for 1904, by M. L. Fuller, E. F. Lines, and A. C. Veatch. 1905. 106 pp. 10c.

Discusses the importance of accurate well records to the driller, to owners of oil, gas, and water wells, and to the geologist; describes the general methods of work; gives tabulated records of wells in Illinois and Iowa, and detailed records of wells in Boone, Dupage, Henry, and La Salle counties, Ill., and Des Moines and Scott counties, Iowa. These wells were selected because they give definite stratigraphic information.

*298. Record of deep-well drilling for 1905, by M. L. Fuller and Samuel Sanford. 1906. 299 pp. 25c.

Gives an account of progress in the collection of well records and samples; contains tabulated records of wells in Illinois, Indiana, Iowa, Minnesota, Missouri, North Dakota, South Dakota, and Wisconsin; and detailed records of wells in Brown, Hancock, La Salle, Pike, and Schuyler counties, Ill.; Blackhawk, Floyd, Louisa, Mahaska, Scott, and Wapello counties, Iowa; and Hennepin, Ottertail, and Pine counties, Minn. The wells of which detailed sections are given were selected because they afford valuable stratigraphic information.

GEOLOGIC FOLIOS.

Under the plan adopted for the preparation of a geologic map of the United States the entire area is divided into small quadrangles bounded by certain meridians and parallels, and these quadrangles, which number several thousand, are separately surveyed and mapped.[1] The unit of survey is also the unit of publication, and the maps and description of each quadrangle are issued in the form of a folio. When all the folios are completed they will constitute the Geologic Atlas of the United States.

A folio is designated by the name of the principal town or of a prominent natural feature within the quadrangle. Each folio includes maps showing the topography, geology, underground structure, and mineral deposits of the area mapped and several pages of descriptive text. The text explains the maps and describes the topographic and geologic features of the country and its mineral products. The topographic map shows roads, railroads, waterways, and, by contour lines, the shapes of hills and valleys and the height above sea level of all points in the qaudrangle. The areal-geology map shows the distribution of the various rocks at the surface. The structural-geology map shows relations of the rocks to one another underground. The economic-geology map indicates the location of mineral deposits that are commercially valuable. The artesian water map shows the depth to underground-water horizons. Economic-geology and artesian-water maps are included in folios if the conditions in the areas mapped warrant their publication. The folios are of special interest to students of geography and geology and are valuable as guides in the development and utilization of mineral resources.

The folios numbered from 1 to 163, inclusive, are published in only one form (18 by 22 inches), called the library edition. Some of the folios that bear numbers higher than 163 are published also in an octavo edition (6 by 9 inches). Owing to a fire in the Geological Survey building May 18, 1913, the stock of geologic folios was more or less damages by fire and water, but 80 or 90 per cent of the folios are usable. They will be sold at the uniform price of 5 cents each, with no reduction for wholesale orders. This rate applies to folios in stock from 1 to 184, inclusive (except reprints), also to the library edition of folio 186. The library edition of folios 185, 187, and higher numbers sells for 25 cents a copy, except that some folios which contain an unusually large amount of matter sell at higher prices. The octavo edition of folio

[1] Index maps showing areas in the Hudson Bay and upper Mississippi River basins covered by topographic maps and by geologic folios will be mailed on receipt of request addressed to the Director, U. S. Geological Survey, Washington, D. C.

185 and higher numbers sells for 50 cents a copy. A discount of 40 per cent is allowed on an order for folios or for folios together with topographic maps amounting to $5 at the retail rate.

All the folios contain descriptions of the drainage of the quadrangles. The folios in the following list contain also a brief discussion of the underground waters in connection with the economic resources of the areas and more or less information concerning the utilization of the water resources.

An asterisk (*) indicates that the stock of the folio is exhausted.

117. Casselton-Fargo, North Dakota-Minnesota. 5c.

Gives a somewhat detailed account of the water supply, including descriptions and logs of principal wells and tabulated well records, contains artesian-water maps showing areas which will probably yield flowing wells.

*145. Lancaster-Mineral Point, Wisconsin-Iowa-Illinois.

Discusses the springs, shallow and deep wells, streams and water power; gives analyses of artesian water from well at Dubuque, Iowa.

168. Jamestown-Tower (Jamestown, Eckelson, and Tower quadrangles), North Dakota.[1] 5c.

Discusses shallow, deep, and artesian wells; head, pressure, power, volume, and character of the water, and gives a tabulated list of representative wells; contains an artesian-water map showing areas in which flowing wells may probably be obtained.

185. Murphysboro-Herrin, Illinois.[1] Library edition, 25c., octavo edition, 50c.

188. Tallula-Springfield, Illinois.[1] Library edition, 25c., octavo edition, 50c.

Discusses wells and the wholesomeness of the water; gives analyses of water from wells in the city of Springfield.

195. Belleville-Breese, Illinois. 25c.

Discusses wells and gives analyses of water from springs and wells.

200. Galena-Elizabeth, Illinois-Iowa. 25c.

201. Minneapolis-St. Paul, Minnesota.[1] Library edition, 25c., octavo edition, 50c.

MISCELLANEOUS REPORTS.

Other Federal bureaus and the State and other organizations have from time to time published reports relating to the water resources of the various sections of the country. Notable among those pertaining to the Hudson Bay and upper Mississippi River basins are the reports of the State surveys of Illinois and North Dakota, the Wisconsin Geological and Natural History Survey and the Railroad Commission of Wisconsin, the Illinois Water-Supply Commission, and the Rivers and Lakes Commission of Illinois, and the water-power report of the Tenth Census (vol. 17). The following reports deserve special mention:

Contributions to the physical geography of the United States, Part I. On the physical geography of the Mississippi Valley, with suggestions for the improvement of navigation of the Ohio and other rivers, by Charles Ellet, jr.: Smithsonian Pub. 13, Washington, 1850.

The Mississippi and Ohio rivers, by Charles H. Ellet. 1853.

Report upon the physics and hydraulics of the Mississippi River, by A. A. Humphreys and H. L. Abbott.

[1] Issued in two editions; specify which edition is wanted.

The mineral content of Illinois waters, by Edward Barstow, J. A. Udden, S. W. Parr, and George T. Palmer: Illinois State Geol. Survey Bull. 10, 1909.

Water resources of the East St. Louis district, by Isaiah Bowman: Illinois State Geol. Survey Bull. 5, 1907.

Chemical and biological survey of waters of Illinois, by Edward Bartow: Univ. Illinois Pub. 3, 6, 7, 1906–1909.

Chemical survey of the waters of Illinois, report for the years 1897–1902, by A. W. Palmer, with report on geology of Illinois as related to its water supply, by Charles W. Rolfe: Univ. Illinois Pub.

Report and plans for the reclamation of lands subject to overflow in the Kaskaskia River Valley, Illinois; begun under the direction of the Internal Improvement Commission; completed and published under the direction of the Rivers and Lakes Commission of Illinois, by Jacob A. Harman. 1912.

Diversion of the waters of the Great Lakes by way of the sanitary and ship canal of Chicago: A brief of the facts and issues, by Lyman E. Cooley, Chicago. 1913.

The State of Missouri *vs.* the State of Illinois and the Sanitary district of Chicago, before Frank S. Bright, Commissioner of the Supreme Court of the United States. 1904.

The mineral waters of Indiana, their location, origin, and character, by W. S. Blatchley: Indiana Dept. Geology and Nat. Res. Twenty-sixth Ann. Rept., 1901.

Report of the water-resources investigation of Minnesota by the State drainage commission, 1910.

Report of the commission on conservation [Montana] on bills relating to the public lands, water rights, and the protection and preservation of the forests, 1911.

Governor's message relating to conservation [in Montana] on bills relating to public lands, water rights, and the protection and preservation of the forests.

Water resources of the Devils Lake region, North Dakota, by E. J. Babcock: North Dakota Geol. Survey, Second Bienn. Rept., 1903.

The water powers of Wisconsin, by Leonard S. Smith: Wisconsin Geol. and Nat. Hist. Survey Bull. 20. Madison, Wis., 1908.

Report of the Railroad Commission of Wisconsin to the legislature on water powers. Madison, Wis., 1915.

Many of these reports can be obtained by applying to the several organizations, and most of them can be consulted in the public libraries of the larger cities.

GEOLOGICAL SURVEY HYDROLOGIC REPORTS OF GENERAL INTEREST.

The following list comprises reports not readily classifiable by drainage basins and covering a wide range of hydrologic investigations:

WATER-SUPPLY PAPERS.

*1. Pumping water for irrigation, by H. M. Wilson. 1896. 57 pp., 9 pls.

Describes pumps and motive powers, windmills, water wheels, and various kinds of engines; also storage reservoirs to retain pumped water until needed for irrigation.

*3. Sewage irrigation, by G. W. Rafter. 1897. 100 pp., 4 pls. (See Water-Supply Paper 22.) 10c.

Discusses methods of sewage disposal by intermittent filtration and by irrigation; describes utilization of sewage in Germany, England, and France, and sewage purification in the United States.

*8. Windmills for irrigation, by E. C. Murphy. 1897. 49 pp., 8 pls. 10c.

Gives results of experimental tests of windmills during the summer of 1896 in the vicinity of Garden, Kansas; describes instruments and methods and draws conclusions.

*14. New tests of certain pumps and water lifts used in irrigation, by O. P. Hood. 1898. 91 pp., 1 pl.

Discusses efficiency of pumps and water lifts of various types.

*20. Experiments with windmills, by T. O. Perry. 1899. 97 pp., 12 pls. 15c.

Includes tables and descriptions of wind wheels, compares wheels of several types, and discusses results.

*22. Sewage irrigation, Part II, by G. W. Rafter. 1899. 100 pp., 7 pls. 15c.

Gives résumé of Water-Supply Paper 3; discusses pollution of certain streams, experiments on purification of factory wastes in Massachusetts, value of commercial fertilizers, and describes American sewage-disposal plants by States; contains bibliography of publications relating to sewage utilization and disposal.

*41. The windmill; its efficiency and economic use, Part I, by E. C. Murphy. 1901. 72 pp., 14 pls. 5c.

*42. The windmill; its efficiency and economic use, Part II, by E. C. Murphy. 1901. 75 pp. (73–147), 2 pls. (15–16). 10c.

Nos. 41 and 42 give details of results of experimental tests with windmills of various types.

*43. Conveyance of water in irrigation canals, flumes, and pipes, by Samuel Fortier. 1901. 86 pp., 15 pls. 15c.

*56. Methods of stream measurement. 1901 51 pp., 12 pls. 15c.

Describes the methods used by the Survey in 1901-2. (See also Nos. 64, 94, and 95.)

*64. Accuracy of stream measurements, by E. C. Murphy. 1902. 99 pp. 4. pls. (See No. 95.) 10c.

Describes methods of measuring velocity of water and of measuring and computing stream flow, and compares results obtained with the different instruments and methods; describes also experiments and results at the Cornell University hydraulic laboratory. A second, enlarged, edition published as Water-Supply Paper 95.

*67. The motions of underground waters, by C. S. Slichter. 1902. 106 pp., 8 pls. 15c.

Discusses origin, depth, and amount of ground waters; permeability of rocks and porosity of soils; causes, rates, and laws of motions of ground waters; surface and deep zones of flow, and recovery of waters by open wells and artesian and deep wells; treats of the shape and position of the water table; gives simple methods of measuring yields of flowing wells; describes artesian wells at Savannah, Ga.

72. Sewage pollution in the metropolitan area near New York City and its effect on inland water resources, by M. O. Leighton. 1902. 75 pp., 8 pls. 10c.

Defines "normal" and "polluted" waters and discusses the damage resulting from pollution.

*80. The relation of rainfall to run-off, by G. W. Rafter. 1903. 104 pp. 10c.

Treats of measurements of rainfall and laws and measurements of streams flow: gives formulas for rainfall, run-off, and evaporation; discusses effects of forests on rainfall and run-off.

87. Irrigation in India (second edition), by H. M. Wilson. 1903. 238 pp., pls. 25c.

First edition was published in Part II of the Twelfth Annual Report.

93. Proceeding of first conference of engineers of the Reclamation Service, with accompanying papers, compiled by F. H. Newell, Chief Engineer. 1904. 361 pp. 25c. [Requests for this report should be addressed to the U. S. Reclamation Service.]

Contains the following papers of more or less general interest:
Limits of an irrigation project, by D. W. Ross.
Relation of Federal and State laws to irrigation, by Morris Bien.
Electrical transmission of power for pumping, by H. A. Storrs.
Correct design and stability of high masonry dams, by Geo. Y. Wisner.
Irrigation surveys and use of the plane table, by J. V. Lippincott.
The use of alkaline waters for irrigation, by Thomas H. Means.

*94. Hydrographic manual of the United States Geological Survey, prepared by E. C. Murphy, J. C. Hoyt, and G. B. Hollister. 1904. 76 pp., 3 pls. 10c.

Gives instruction for field and office work relating to measurements of stream flow by current meters. (See also No. 95.)

*95. Accuracy of stream measurements (second, enlarged edition), by E. C. Murphy 1904. 169 pp., 6 pls.

Describes methods of measuring and computing stream flow and compares results derived from different instruments and methods. (See also No. 94.)

*103. A review of the laws forbidding pollution of inland water in the United States, by E. B. Goodell. 1904. 120 pp. (See No. 152.)

Explains the legal principles under which antipollution statues become operative, quotes court decisions to show authority for various deductions, and classifies according to scope the statutes enacted in the different States.

110. Contributions to the hydrology of Eastern United States; 1904, M. L. Fuller, geolgist in charge. 1905. 211 pp., 5 pls. 10c.

Contains the following reports of general interest. The scope of each paper is indicated by its title.
Description of under flow meter used in measuring the velocity and direction of underground water, by Charles S. Slichter.
The California or "stovepipe" method of well construction, by Charles S. Slichter.
Approximate methods of measuring the yield of flowing wells, by Charles S. Slichter.
Corrections necessary in accurate determinations of flow from verticals well casings, from notes furnished by A. N. Talbot.

113. The disposal of strawboard and oil-well wastes, by R. L. Sackett and Isaiah Bowman. 1905. 52 pp., 4 pls. 5c.

The first paper discusses the pollution of stream by sewage and by trade wastes, describes the manufacture of strawboard, and gives results of various experiments in disposing of the waste. The second paper describes briefly the topography, drainage, and geology of the region about Marion, Ind., and the contamination of rock wells and of streams by waste oil and brine.

*114. Underground waters of eastern United States; M. L. Fuller, geologist in charge. 1905. 285 pp., 18 pls. 25c.

Contains reports on "Occurrence of underground waters," by M. L. Fuller, discussing sources, amount, and temperature of waters, permeability and storage capacity of rocks, water-bearing formations, recovery of water by springs, wells, and pumps, essential conditions of artesian flows, and general conditions affecting ground waters in eastern United States.

119. Index to the hydrographic progress reports of the United States Geological Survey, 1888 to 1903, by J. C. Hoyt and B. D. Wood. 1905. 253 pp. 15c.

120. Bibliographic review and index of papers relating to underground waters published by the United States Geological Survey, 1879–1904, by M. L. Fuller 1905. 128 pp. 10c.

*122. Relation of the law to underground waters, by D. W. Johnson. 1905. 55 pp. 5c.

Defines and classifies underground waters, gives common-law rules relating to their use and cities State legislative acts affecting them.

140. Field measurements of the rate of movement of underground waters, by C. S. Slitcher. 1905. 122 pp., 15 pls. 15c.

Discusses the capacity of sand to transmit water, describes measurements of underflow in Rio Hondo, San Gabriel, and Mohave River valleys, Cal., and on Long Island, N. Y., gives results of tests of wells and pumping plants, and describes stovepipe method of well construction.

143. Experiments on steel-concrete pipes on a working scale, by J. H. Quinton. 1905. 61 pp., 4 pls. 5c.

Scope indicated by title.

145. Contributions to the hydrology of eastern United States, 1905; M. L. Fuller, geologist in charge. 1905. 220 pp., 6 pls. 10c.

Contains brief reports of general interest as follows:

Drainage of ponds into drilled wells, by Robert E. Horton. Disscuses efficiency, cost, and capacity of drainage wells, and gives statistics of such well in Southern Michigan.

Construction of so-called fountain and geyser springs, by Myron L. Fuller.

A convenient gage for determining low artesian heads, by Myron L. Fuller.

146. Proceedings of second conference of engineers of the Reclamation Service, with accompanying papers, compiled by F. H. Newell, Chief Engineer. 1905. 267 pp. 15c. [Inquiries concerning this report should be addressed to the Reclamation Service.]

Contains brief account of the organization of the hydrographic [water-resources] branch and the Reclamation Service, reports of conferences and committees, circulars of instruction, and many brief reports on subjects closely related to reclamation, and a bibiliography of technical papers by members of the service. Of the papers read at the conference those listed below (scope indicated by title) are of more or less general interest.

Proposed State code of water laws, by Morris Bien.
Power engineering applied to irrigation problems, by O. H. Ensign.
Estimates on tunneling in irrigation projects, by A. L. Fellows
Collection of steam-gaging data, by N. C. Grover.
Diamond-drill methods, G. A. Hammond.
Mean-velocity and area curves, by F. W. Hanna.
Importance of general hydrographic data concerning basins of streams gaged, by R. E. Horton.
Effect of aquatic vegetation on stream flow, by R. E. Horton.
Sanitary regulations governing construction camps, by M. O. Leighton.
Necessity of draining irrigated land, by Thos. H. Means.
Alkali soils, by Thos. H. Means.
Cost of stream gaging work, by E. C. Murphy.
Equipment of a cable gaging station, by E. C. Murphy.
Silting of reservoirs, by W. M. Reed.
Farm-unit classification, by D. W. Ross.
Cost of power for pumping irrigated water, by H. A. Storrs.
Records of flow at current-meter gaging stations during the frozen season, by F. H. Tillinghast.

147. Destructive floods in United States in 1904, by E. C. Murphy and others. 1905. 206 pp., 18 pls. 15c.

Contains a brief account of "A method of computing cross-section area of waterways," including formulas for maximum discharge and areas of cross section.

*150. Weir experiments, coefficients, and formulas, by R. E. Horton. 1906. 189 pp., 38 pls. (See Water-Supply Paper 200.) 15c.

Scope indicated by title.

151. Field assay of water, by M. O. Leighton. 1905. 77 pp., 4 pls.

Discusses methods, instruments, and reagents used in determining turbidity, color, iron, chlorides, and hardness in connection with the studies of the quality of water in various parts of the United States.

*152. A review of the laws forbidding pollution of inland waters in the United States, second edition, by E. B. Goodell. 1905. 149 pp.

Scope indicated by title.

*155. Fluctuations of the water level in wells, with special reference to Long Island. N. Y., A. C. Veatch. 1906. 83 pp., 9 pls. 25c.

Includes general discussion of fluctuations due to rainfall and evaporation, barometric changes, temperature changes, changes in rivers, changes in lake level, tidal changes, effects of settlement, irrigation, dams, underground-water developments, and to indeterminate causes.

*160. Underground water papers. 1906; M. L. Fuller, geologist in charge. 1906. 104 pp., 1 pl.

Gives account of work in 1905; lists publications relating to underground waters, and contains the following brief reports of general interest:

Significance of the term "artesian," by Myron L. Fuller.
Representation of wells and springs on maps, by Myron L. Fuller.
Total amount of free water in the earth's crust, by Myron L. Fuller.
Use of fluorescein in the study of underground waters, by R. B. Dole.
Problems of water contamination, by Isaiah Bowman.
Instances of improvement of water in wells, by Myron L. Fuller.

*162. Destructive floods in the United States in 1905, with a discussion of flood discharge and frequency and an index to flood literature, by E. C. Murphy and others. 1906. 105 pp., 4 pls. 15c.

*163. Bibligoraphic review and index of underground-water literature published in the United States in 1905, by M. L. Fuller, F. G. Clapp, and B. L. Johnson. 1906. 130 pp. 15c.

Scope indicated by title.

*179. Prevention of stream pollution by distillery refuse, based on investigations at Lynchburg, Ohio, by Herman Stabler. 1906. 34 pp., 1 pl. 10c.

Describes grain distillation, treatment of slop, sources, character, and effects of effluents on streams; discusses filtration, precipitation, fermentation, and evaporation methods of disposal of wastes without pollution.

*180. Turbine water-wheel tests and power tables, by R. E. Horton. 1906. 134 pp., 2 pls. 20c.

Scope indicated by title.

*185. Investigations on the purification of Boston sewage, * * * with a history of the sewage-disposal problem, by C.-E. A. Winslow and E. B. Phelps. 1906. 163 pp. 25c.

Discusses composition, disposal, purification, and treatment of sewages and tendencies in sewage-disposal practice in England, Germany, and the United States; describes character of crude sewage at Boston, removal of suspended matter, treatment in septic tanks, and purification by intermittent sand filtration and in beds of course material; gives bibliography.

*186. Stream pollution by acid-iron wastes, a report based on investigations made at Shelby, Ohio, by Herman Stabler. 1906. 36 pp., 1 pl.

Gives history of pollution by acid-iron wastes at Shelby, Ohio, and of resulting litigation; discusses effect of acid-iron liquors of sewage-purification processes, recovery of copperas from acid-iron wastes, and other processes for removal of pickling liquor.

*187. Determination of stream flow during the frozen season, by H. K. Barrows and R. E. Horton. 1907. 93 pp., 1 pl. 15c.

Scope indicated by title.

*189. The prevention of stream pollution by strawboard waste, by E. B. Phelps. 1906. 29 pp., 2 pls.

Describes manufacture of strawboard, present and proposed methods of disposal of waste liquors, laboratory investigations of precipitation and sedimentation, and field studies of amounts and character of water used, raw material and finished product, and mechanical filtration.

*194. Pollution of Illinois and Mississippi rivers by Chicago sewage (a digest of the testimony taken in the case of the State of Missouri v. The State of Illinois and the Sanitary District of Chicago), by M. O. Leighton. 1907. 369 pp., 2 pls.

Scope indicated by amplification of title.

*200. Weir experiments, coefficients, and formulas (revision of paper No. 150), by R. E. Horton. 1907. 195 pp., 1 pl. 35c.

Scope indicated by title.

*226. The pollution of streams by sulphite-pulp waste, a study of possible remedies by E. B. Phelps. 1909. 37 pp., 1 pl. 10c.

Describes manufacture of sulphite pulp, the waste liquors, and the experimental work leading to suggestions as to methods of preventing stream pollution.

*229. The disinfection of sewage and sewage filter effluents, with a chapter on the putrescibility and stability of sewage effluents, by E. B. Phelps. 1909. 91 pp., 1 pl. 15c.

Scope indicated by title.

*234. Papers on the conversion of water resources. 1909. 96 pp., 2 pls. 15c.

Contains the following papers, whose scope is indicated by their titles: Distribution of fall, by Henry Gannett; Floods, by M. O. Leighton; Developed water powers, compiled under the direction of W. M. Steuart, with discussion by M. O. Leighton; Undeveloped water powers, by M. O. Leighton; Irrigation, by F. H. Newell; Underground waters, by W. C. Mendenhall; Denudation, by R. B. Dole and Herman Stabler; Control of catchment areas, by H. N. Parker.

*235. The purification of some textile and other factory wastes, by Herman Stabler. and G. H. Pratt. 1909. 76 pp. 10c.

Discusses waste waters from wool-scouring, bleaching, and dyeing cotton yarn, bleaching cotton piece goods, and manufacture of oleomargarine, fertilizer, and glue.

236. The quality of surface waters in the United States: Part I, Analyses of waters east of the one hundredth meridian, by R. B. Dole. 1909. 123 pp. 10c.

Describes collection of samples, methods of examination, preparation of solutions, accuracy of estimates, and expression of analytical results.

238. The public utility of water powers and their governmental regulation, by René Tavernier and M. O. Leighton. 1910. 161 pp. 15c.

Discusses hydraulic power and irrigation, French, Italian, and Swiss legislation relative to the development of water powers, and laws proposed in the French Parliament; reviews work of bureau of hydraulics and agricultural improvement of the French department of agriculture and gives résumé of Federal and State water-power legislation in the United States.

*255. Underground waters for farm use, by M. L. Fuller. 1910. 58 pp., 17 pls. 15c.

Discusses rocks as sources of water supply and the relative saftey of supplies from different materials; springs, and their protection; open or dug and deep wells, their location, yields, relative cost, protection, and safety; advantages and disadvantages of cisterns and combination wells and cisterns.

*257. Well-drilling methods, by Isaiah Bowman. 1911. 139 pp., 4 pls. 15c.

Discusses amount, distribution, and disposal of rainfall, water-bearing rocks, amount of ground water, artesian conditions, and oil and gas bearing formations; gives history of well drilling in Asia, Europe, and the United States; describes in detail the various methods and the machinery used; discusses loss of tools and geologic difficulties; contamination of well waters and methods of prevention; tests of capacity and measurement of depth; and costs of sinking wells.

*258. Underground water papers, 1910, by M. L. Fuller, F. G. Clapp, G. C. Matson, Samuel Sanford, and H. C. Wolff. 1911. 123 pp., 2 pls. 15c.

Contains the following papers (scope indicated by titles) of general interest:
Drainage by wells, by M. L. Fuller.
Freezing of wells and related phenomena, by M. L. Fuller.
Pollution of underground waters in limestone, by G. C. Matson.
Protection of shallow wells in sandy deposits, by M. L. Fuller.
Magnetic wells, by M. L. Fuller.

274. Some stream waters of the western United States, with chapters on sediment carried by the Rio Grande and the industrial application of water analyses, by Herman Stabler. 1911. 188 pp. 15c.

Describes collection of samples, plan of analytical work, and methods of analyses; discusses soap-consuming power of waters, water softening, boiler waters, and water for irrigation.

*315. The purification of public water supplies, by G. A. Johnson. 1913. 84 pp., 8 pls. 10c.

Discusses ground, lake, and river waters as public supplies, development of waterworks systems in the United States, water consumption, and typhoid fever; describes methods of filtration and sterlization of water, and municipal water softening.

334. The Ohio Valley flood of March–April, 1913 (including comparisons with some earlier floods), by A. H. Horton and H. J. Jackson. 1913. 96 pp., 22, pls. 20c.

Although relating specifically to floods in the Ohio Valley, this report discusses also the causes of floods and the prevention of damage by floods.

337. The effects of ice on stream flow, by William Glenn Hoyt. 1913. 77 pp., 7 pls. 15c.

Discusses methods of measuring the winter flow of streams.

*345. Contributions to the hydrology of the United States, 1914; N. C. Grover, chief hydraulic engineer. 1915. 225 pp., 17 pls. 30c. Contains:

(e) A method of determining the daily discharge of rivers of variable slope, by M. R. Hall, W. E. Hall, and C. H. Pierce, pp. 53–65.

364. Water analyses from the laboratory of the United States Geological Survey, tabulated by F. W. Clarke, chief chemist. 1914; 40 pp 5c.

Contains analyses of waters from rivers, lakes, wells, and springs in various parts of the United States, including analyses of the geyser water of Yellowstone National Park, hot springs in Montana, brines from Death Valley, water from the Gulf of Mexico, and mine waters from Tennessee, Michigan, Missouri and Oklahoma, Montana, Colorado, and Utah, Nevada and Arizona, and California.

371. Equipment for current-meter gaging stations, by G. J. Lyon. 1915. 64 pp., 37 pls. 20c.

Describes methods of installing automatic and other gages and of constructing gage wells, shelters, and structures for making discharge measurements and artificial controls.

*375. Contributions to the hydrology of the United States, 1915; N. C. Grover, chief hydraulic engineer. 1916. 181 pp., 9 pls. 15c.

Contains three papers presented at the conference of engineers of the water-resources branch in December, 1914.

* (c) The relation of steam gaging to the science of hydraulics, by C. H. Pierce and R. W. Davenport, pp. 77–84.

(e) A method for correcting river discharge for changing stage, by B. E. Jones, pp. 117–130.

(f) Conditions requiring the use of automatic gages in obtaining records of steam flow, by C. H. Pierce, pp. 131–139.

*400. Contributions to the hydrology of the United States, 1916; N. C. Grover, chief hydraulic engineer. 1917. 108 pp., 7 pls. Contains:

(a) The people's interest in water-power resources, by G. O. Smith, pp. 1-8.
* (c) The measurement of silt-laden streams, by R. C. Pierce, pp. 39-51.
(d) Accuracy of stream-flow data, by N. C. Grover and J. C. Hoty, pp. 53-59.

416. The divining rod, a history of water witching, with a bibliography, by Arthur J. Ellis. 1917. 59 pp. 10c.

A brief paper published "merely to furnish a reply to the numerous inquiries that are continually being received from all parts of the country" as to the efficacy of the divining rod for locating underground water.

425. Contributions to the hydrology of the United States, 1917; N. C. Grover, chief hydraulic engineer. 1918. Contains:

(c) Hydraulic conversion tables and convenient equivalents, pp. 71-94. 1917.

427. Bibliography and index of the publications of the United States Geological Survey relating to ground water, by O. E. Meinzer. 1918. 169 pp., 1 pl.

Includes publications prepared, in whole or part, by the Geological Survey that treat any phase of the subject of ground water or any subject directly applicable to ground water. Illustrated by map showing reports that cover specific areas more or less thoroughly.

ANNUAL REPORTS.

*Fifth Annual Report of the United States Geological Survey, 1883-84, J. W. Powell, Director. 1885. xxxvi, 469 pp., 58 pls. $2.25. Contains:

* The requisite and qualifying conditions of artesian wells, by T. C. Chamberlin, pp. 125-173, pl. 21. Scope indicated by title.

Twelfth Annual Report of the United States Geological Survey, 1890-91, J. W. Powell, Director. 1891. 2 parts. *Pt. II, Irrigation, xviii, 576 pp., 93 pls. $2. Contains:

* Irrigation in India, by H. M. Wilson, pp. 368-561, pls. 107 to 146. See Water-Supply Paper 87.

Thirteenth Annual Report of the United States Geological Survey, 1891-92, J. W. Powell, Director. 1892. (Pts. II and III, 1893.) 3 parts. *Pt. III, Irrigation, xi, 486 pp., 77 pls. $1.85. Contains:

* American irrigation engineering, by H. M. Wilson, pp. 101-349, pls. 111 to 145. Discusses the economic aspects of irrigation, alkaline drainage, silt and sedimentation; gives brief history of legislation; describes perennial canals in Idaho, California, Wyoming, and Arizona; discusses water storage at reservoirs of the California and other projects, subsurface sources of supply, pumping, and subirrigation.

Fourteenth Annual Report of the United States Geological Survey, 1892-93, J. W., Powell, Director. 1893. (Pt. II, 1894.) 2 parts. *Pt. II, Accompanying papers, xx, 597 pp., 73 pls. $2.10. Contains:

* Potable waters of the eastern United States, by W J McGee, pp. 1 to 47. Discusses cistern water, stream waters, and ground waters, including mineral springs and artesian wells.

* Natural mineral waters of the United States, by A. C. Peale, pp. 49-88, pls. 3 and 4. Discusses the origin and flow of mineral springs, the source of mineralization, thermal springs, the chemical composition and analysis of spring waters, geographic distribution, and the utilization of mineral waters; gives a list of American mineral spring resorts; contains also some analyses.

Nineteenth Annual Report of the United States Geological Survey, 1897-98, Charles D. Walcott, Director. 1898. (Parts II, III, and V, 1899.) 6 parts in 7 vols. and separate case for maps with Pt. V. *Pt. II.—Papers chiefly of a theoretic nature, v, 958 pp., 172 pls. $2.65. Contains:

* Principles and conditions of the movements of ground water, by F. H. King, pp. 59-294, pls. 6 to 16. Discusses the amount of water stored in sandstone, in soil, and in other rocks, the depth to which ground water penetrates; gravitational, thermal, and capillary movements of ground waters, and the configuration of the ground-water surface; gives the results of experimental investigations on the flow of air and water through a rigid, porous medium and through

sands, sandstones, and silts; discusses results obtained by other investigators, and summarizes results of observations; discusses also rate of flow of water through sand and rock, the growth of rivers, rate of filtration through soil, interference of wells, etc.

* Theoretical investigation of the motion of ground waters, by C. S. Slichter, pp. 295–384, pl. 17. Scope indicated by title.

PROFESSIONAL PAPERS.

*72. Denudation and erosion in the southern Appalachian region and the Monongahela basin, by L. C. Glenn. 1911. 137 pp., 21 pls. 35c.

Describes the topography, geology, drainage, forests, climate and population, and transportation facilities of the region, the relation of agricultural lumbering, mining, and power development to erosion and denudation, and the nature, effects, and remedies of erosion; gives details of conditions in Holston, Nolichucky, French Broad, Little Tennessee, and Hiwassee river basins, along Tennessee River proper, and in the basins of the Coosa-Alabama system, Chattahoochee, Savannah, Saluda, Broad, Catawba, Yadkin, New, and Monongahela rivers.

86. The transportation of débris by running water, by G. K. Gilbert, based on experiments made with the assistance of E. C. Murphy. 1914. 263 pp., 3 pls. 70c.

The results of an investigation which was carried on in a specially equipped laboratory at Berkeley, Cal., and was undertaken for the purpose of learning "the laws which control the movement of bed load and especially to determine how the quantity of load is related to the stream slope and discharge and to the degree of comminution of the débris."

105. Hydraulic-mining débris in the Sierre Nevada, by G. K. Gilbert. 154 pp., 34 pls. 1917. 50c.

Presents the results of an investigation undertaken by the United States Geological Survey in response to a memorial from the California Miners' Association asking that a particular study be made of portions of the Sacramento and San Joaquin valleys affected by detritus from torrential streams. The report deals largely with geologic and physiographic aspects of the subject, traces the physical effects, past and future, of the hydraulic mining of earlier decades, the similar effects which certain other industries induce through stimulation of the erosion of the soil, and the influence of the restriction of the area of inundation by the construction of levees. Suggests cooperation by several interests for the control of the streams now carrying heavy loads of débris.

BULLETINS.

*32. Lists and analyses of the mineral springs of the United States (a preliminary study), by A. C. Peale. 1886. 235 pp.

Defines mineral waters, lists the springs by State, and gives table of analyses.

*319. Summary of the controlling factors of artesian flows, by Myron L. Fuller. 1908. 44 pp. 7 pls. 10c.

Describes underground reservoirs, the source of ground waters, the confining agents, the primary and modifying factors of artesian circulation, the essential and modifying factors of artesian flow, and typical artesian systems.

*479. The geochemical interpretation of water analyses, by Chase Palmer. 1911. 31 pp. 5c.

Discusses the expression of chemical analyses, the chemical character of water and the properties of natural waters; gives a classification of waters based on property values and reacting values, and discusses the character of the waters of certain rivers as interpreted directly from the results of analyses; discusses also the relation of water properties to geological formations, silica in river water, and the character of the water of the Mississippi and the Great Lakes and St. Lawrence River as indicated by chemical analyses.

616. The data of geochemistry (third edition), by F. W. Clarke. 1916. 821 pp. 45c.

Earlier editions were published as Bulletins 330 and 491. Contains a discussion of the statement and interpretation of water analyses and a chapter on "Mineral wells and springs" (pp. 179-216). Discusses the definition and classification of mineral waters, changes in composition of water, deposits of calcareous, ocherous, and siliceous materials made by water, vadose and juvenile waters, and thermal springs in relation to volcanism. Describes the different kinds of ground water and gives typical analyses. Includes a brief bibliography of papers containing water analyses.

INDEX BY AREAS AND SUBJECTS.

[A=Annual Reports; M=Monograph; B=Bulletin; P=Professional Paper; W=Water-Supply Paper, G F=Geologic folio.]

[1] Many of the reports contain brief subject bibliographies See abstracts.

[2] Many analyses of river, spring, and well waters are scattered through publications, as noted in abstracts.

INDEX OF STREAMS.

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JOHN BARTON PAYNE, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

WATER-SUPPLY PAPER 456

SURFACE WATER SUPPLY OF THE UNITED STATES

1917

PART VI. MISSOURI RIVER BASIN

NATHAN C. GROVER, Chief Hydraulic Engineer
W. A. LAMB and ROBERT FOLLANSBEE, District Engineers

Prepared in cooperation with the
STATES OF COLORADO, MONTANA, WYOMING, AND KANSAS

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CONTENTS.

ILLUSTRATIONS.

SURFACE WATER SUPPLY OF MISSOURI RIVER BASIN, 1917.

AUTHORIZATION AND SCOPE OF WORK.

This volume is one of a series of 14 reports presenting results of measurement of flow made on streams in the United States during the year ending September 30, 1917.

The data presented in these reports were collected by the United States Geological Survey under the following authority contained in the organic law (20 Stat. L., p. 394):

Provided, That this officer [the Director] shall have the direction of the Geological Survey and the classification of public lands and examination of the geological structure, mineral resources, and products of the national domain.

The work was begun in 1888 in connection with special studies relating to irrigation in the arid West. Since the fiscal year ending June 30, 1895, successive sundry bills passed by Congress have carried the following item and appropriations:

For gaging the streams and determining the water supply of the United States, and for the investigation of underground currents and artesian wells, and for the preparation of reports upon the best methods of utilizing the water resources.

Annual appropriation for the fiscal years ending June 30, 1895–1918.

1895	$12,500
1896	20,000
1897 to 1900, inclusive	50,000
1901 to 1902, inclusive	100,000
1903 to 1906, inclusive	200,000
1907	150,000
1908 to 1910, inclusive	100,000
1911 to 1917, inclusive	150,000
1918	175,000

In the execution of the work many private and State organizations have cooperated either by furnishing data or by assisting in collecting data. Acknowledgments for cooperation of the first kind are made in connection with the description of each station affected; cooperation of the second kind is acknowledged on page 11.

Measurements of stream flow have been made at about 4,240 points in the United States and also at many points in Alaska and the Hawaiian Islands. In July, 1917, 1,180 gaging stations were being maintained by the Survey and the cooperating organizations. Many miscellaneous discharge measurements are made at other points. In connection with this work data were also collected in regard to precipitation, evaporation, storage reservoirs, river profiles, and water power in many sections of the country and will be made available in water-supply papers from time to time. Information in regard to publications relating to water resources is presented in the appendix to this report.

DEFINITION OF TERMS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups—(1) those that represent a rate of flow, as second-feet, gallons per minute, miner's inches, and discharge in second-feet per square mile, and (2) those that represent the actual quantity of water, as run-off in depth in inches, acre-feet, and millions of cubic feet. The principal terms used in this series of reports are second-feet, second-feet per square mile, run-off in inches, and acre-feet. They may be defined as follows:

"Second-feet" is an abbreviation for "cubic feet per second." A second-foot is the rate of discharge of water flowing in a channel of rectangular cross section 1 foot wide and 1 foot deep at an average velocity of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off (depth in inches)" is the depth to which an area would be covered if all the water flowing from it in a given period were uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

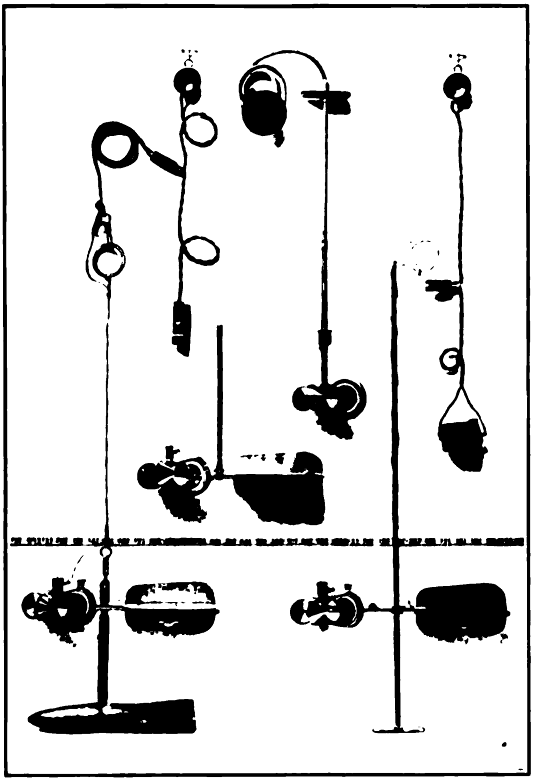
An "acre-foot," equivalent to 43,560 cubic feet, is the quantity required to cover an acre to the depth of 1 foot. The term is commonly used in connection with storage for irrigation.

The following terms not in common use are here defined:

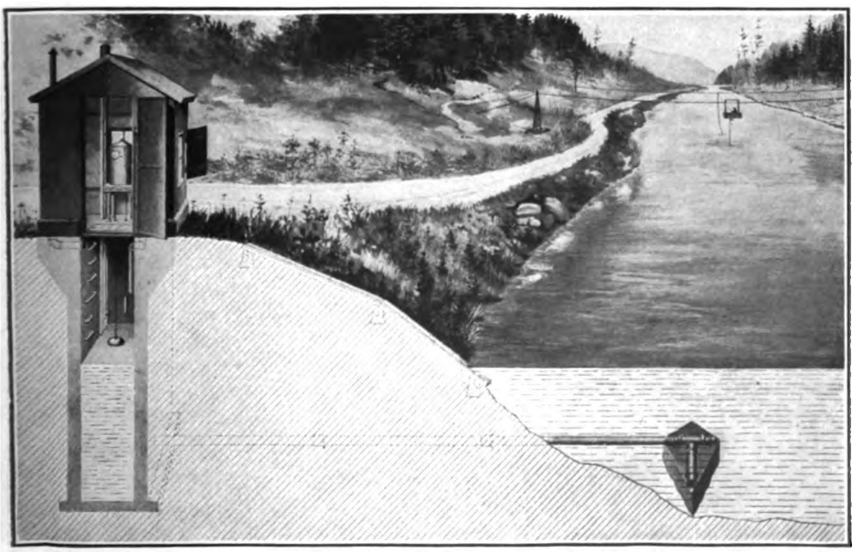
"Stage-discharge relation," an abbreviation for the term "relation of gage height to discharge."

"Control," a term used to designate the section or sections of the stream below the gage which determine the stage-discharge relation at the gage. It should be noted that the control may not be the same section or sections at all stages.

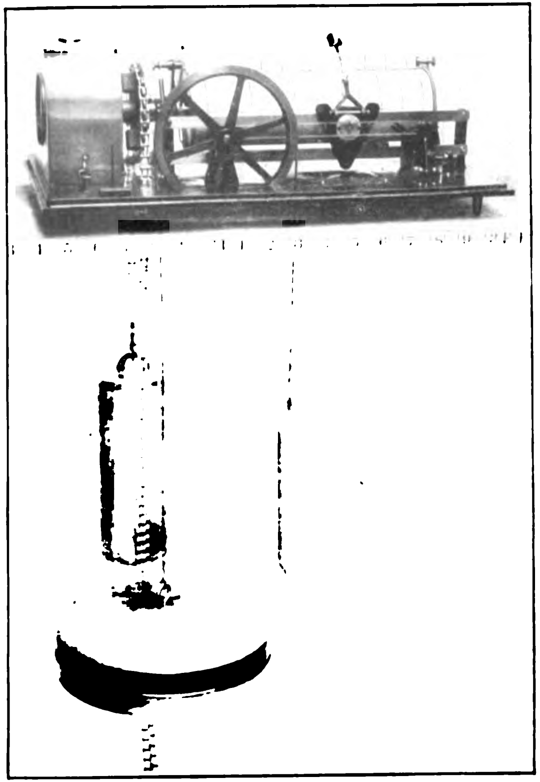
The "point of zero flow" for a given gaging station is that point on the gage—the gage height—to which the surface of the river would fall if there were no flow.



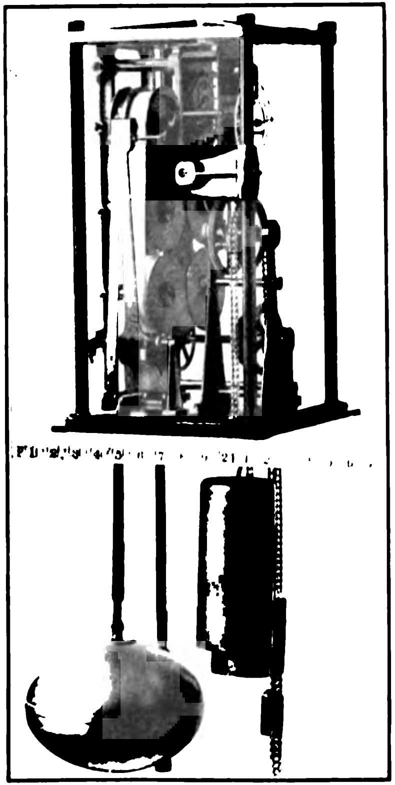
A. PRICE CURRENT METERS.



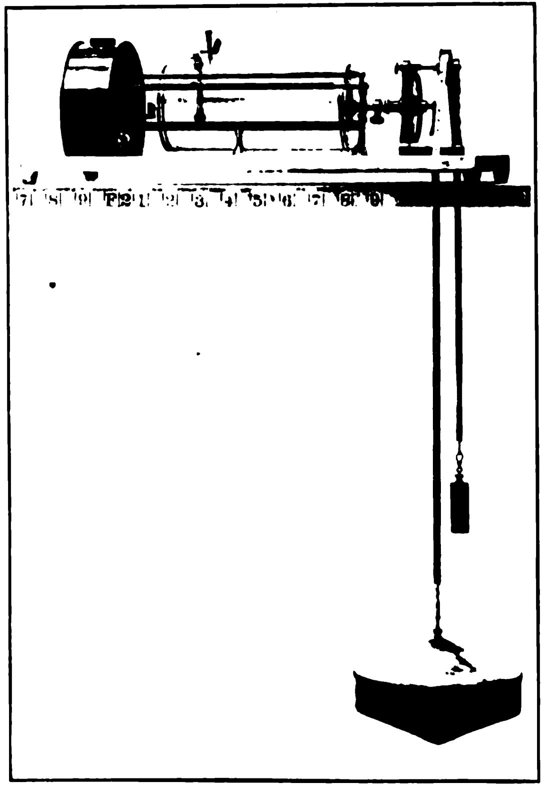
B. TYPICAL GAGING STATION.



A. STEVENS CONTINUOUS.



B. GURLEY PRINTING.



C. FRIEZ.

WATER-STAGE RECORDERS.

EXPLANATION OF DATA.

The data presented in this report cover the year beginning October 1, 1916, and ending September 30, 1917. At the beginning of January in most parts of the United States much of the precipitation in the preceding three months is stored as ground water in the form of snow or ice, or in ponds, lakes, and swamps, and this stored water passes off in the streams during the spring break-up. At the end of September, on the other hand, the only stored water available for run-off is possibly a small quantity in the ground; therefore the run-off for the year beginning October 1 is practically all derived from precipitation within that year.

The base data collected at gaging stations consist of records of stage, measurements of discharge, and general information used to supplement the gage heights and discharge measurements in determining the daily flow. The records of stage are obtained either from direct readings on a staff gage or from a water-stage recorder that gives a continuous record of the fluctuations. Measurements of discharge are made with a current meter. (See Pls. I, II.) The general methods are outlined in standard textbooks on the measurement of river discharge.

From the discharge measurements rating tables are prepared that give the discharge for any stage, and these rating tables, when applied to the gage heights, give the discharge from which the daily, monthly, and yearly mean discharge is determined.

The data presented for each gaging station in the area covered by this report comprise a description of the station, a table giving results of discharge measurements, a table showing the daily discharge of the stream, and a table of monthly and yearly discharge and run-off.

If the base data are insufficient to determine the daily discharge, tables giving daily gage heights and results of discharge measurements are published.

The description of the station gives, in addition to statements regarding location and equipment, information in regard to any conditions that may affect the constancy of the stage-discharge relation, covering such subjects as the occurrence of ice, the use of the stream for log driving, shifting of control, and the cause and effect of backwater. It gives also information as to diversions that decrease the flow at the gage, artificial regulation, maximum and minimum recorded stages, and the accuracy of the records.

The table of daily discharge gives, in general, the discharge in second-feet corresponding to the mean of the gage heights read each day. At stations on streams subject to sudden or rapid diurnal fluctuation the discharge obtained from the rating table and the mean daily gage height may not be the true mean discharge for the day. If such stations are equipped with water-stage recorders, the mean daily discharge may be obtained by averaging discharge at regular intervals during the day, or by using the discharge integrator, an instrument operating on the principle of the planimeter and containing as an essential element the rating curve of the station.

In the table of monthly discharge the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest. As the gage height is the mean for the day, it does not indicate correctly the stage when the water surface was at crest height, and the corresponding discharge was consequently larger than given in the maximum column. Likewise, in the column headed "Minimum," the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow in cubic feet for each second during the month. On this average flow computations recorded in the remaining columns, which are defined on page 8, are based.

ACCURACY OF FIELD DATA AND COMPUTED RESULTS.

The accuracy of stream-flow data depends primarily (1) on the permanence of the stage-discharge relation, and (2) on the accuracy of observation of stage measurements of flow, and interpretation of records.

A paragraph in the description of the station of footnotes added to the tables gives information regarding the (1) permanence of the stage-discharge relation, (2) precision with which the discharge rating curve is defined, (3) refinement of gage readings, (4) frequency of gage readings, and (5) methods of applying daily gage heights to the rating table to obtain the daily discharge.[1]

For the rating tables "well defined" indicates, in general, that the rating is probably accurate within 5 per cent; "fairly well defined," within 10 per cent; "poorly defined," within 15 to 25 per cent. These notes are very general and are based on the plotting of the individual measurements with reference to the mean rating curve.

The monthly means for any station may represent with high accuracy the quantity of water flowing past the gage, but the figures showing discharge per square mile and depth of run-off in inches may be subject to gross errors caused by the inclusion of large noncontributing districts in the measured drainage area, by lack of information concerning water diverted for irrigation or other use, or by inability to interpret the effect of artificial regulation of the flow of the river above the station. "Second-feet per square mile" and "Run-off (depth in inches)" are therefore not computed if such

[1] For a more detailed discussion of the accuracy of stream-flow data see Grover, N. C., and Hoyt, J. C.: Accuracy of stream-flow data: U. S. Geol. Survey Water-Supply Paper 400, pp. 53–59, 1916.

errors appear probable. The computations are also omitted for stations on streams draining areas in which the annual rainfall is less than 20 inches. All figures representing "second-feet per square mile" and "run-off (depth in inches)" previously published by the Survey should be used with caution because of possible inherent sources of error not known to the Survey.

The table of monthly discharge gives only a general idea of the flow at the station and should not be used for other than preliminary estimates. The tables of daily discharge allow more detailed studies of the variation in flow. It should be borne in mind, however, that the observations in each succeeding year may be expected to throw new light on data previously published.

COOPERATION.

Much of the work in Montana has been carried on under cooperative agreement with the United States Reclamation Service, the work being done by the Geological Survey and the expense borne by the Reclamation Service. The legislature of the State of Montana made an appropriation for stream-gaging work, which was expended by the State engineer, as provided in the act, in accordance with paragraph 3, section 2244, of the Revised Codes of 1907 of the State of Montana, which reads as follows:

> The State engineer shall become conversant with the waterways of the State and the needs of the State as to irrigation matters, shall make, or cause to be made, measurements and calculations of the ordinary and flood discharge of streams, cooperating in this work as much as possible with the United States Geological Survey and the Montana Experiment Station; such measurements to be made on streams in order of their importance, provided that measurements already made, if deemed reliable, may be adopted.

This fund was expended largely on work in connection with the several Carey projects in Montana and in computing data on water-right filings and adjudications. A State hydrographer was employed who worked directly with the Geological Survey.

The expense of work on the Crow Reservation in Montana, the Standing Rock Reservation in North and South Dakota, and the Pine Ridge and Rosebud Reservations in South Dakota was borne by the Office of Indian Affairs.

Officials of the Yellowstone National Park have furnished valuable hydrometric and climatic data and paid a large part of the expense of work in the park.

All stations in Wyoming were maintained in cooperation with the State, through Mr. J. B. True, State engineer.

The United States Reclamation Service paid for the maintenance of the stations on North Platte River above Pathfinder, Wyo., and on Sage Creek above Pathfinder.

The Laramie Water Co. furnished gage-height records for the following stations: Laramie River and Pioneer canal near Woods; Laramie River at Two Rivers; Laramie River near Lookout; Laramie River below McGill; and Little Laramie River at Two Rivers.

The Rock Creek Conservation Co., through Mr. Frank C. Bosler, furnished field data for stations on Rock and Deep creeks near Arlington, Wyo. The United States Forest Service furnished gage-height records for Big Creek near Big Creek. The Hawk Springs Development Co., through Mr. J. A. Whiting, furnished record of gage heights and provided transportation necessary to obtain data for the station on Horse Creek near La Grange, Wyo.

The L. Z. Leiter estate, through Mr. J. C. Beebe, manager, furnished gage-height records for station at Ucross, Wyo, and a number of discharge measurements at several stations. Gage-height records were also furnished as follows: The Buffalo Manufacturing Co., for Clear Creek near Buffalo; the Swan Land & Cattle Co., for Chugwater Creek at Chugwater; the Wyoming Irrigation Co. for Shell Creek at Shell, Wyo.

Messrs. Johnson and Cronberg furnished gage-height records and other assistance in connection with the station on Medicine Bow River near Medicine Bow, Wyo., and Mr. F. H. Richards assisted in like manner in obtaining the record at the station on Muddy Creek near Shirley.

Records were furnished by the State engineer of Colorado for Laramie River near Jelm, Wyo., and by the North Laramie Land Co. for North Laramie River near Wheatland, Wyo.

The Farmers' Reservoir & Irrigation Co. furnished the gage-height records and paid for the maintenance of the station on Clear Creek near Golden, Colo. The State engineer paid the gage observers at the following stations in Colorado: South Platte River at South Platte; North Fork of South Platte River at Grant and at South Platte; and Geneva Creek at Grant. The Tarryall Canal & Reservoir Co. paid the expense of maintaining the station on Tarryall Creek near Jefferson, Colo.

In South Dakota the State engineer, Dr. H. M. Derr, paid the observer's salary at the station on Cheyenne River near Hot Springs.

The stations in Kansas were maintained in cooperation with the Kansas Water Commission.

DIVISION OF WORK.

Data for stations in the upper Missouri River basin in Montana and North Dakota were collected and prepared for publication under the direction of W. A. Lamb, district engineer, who was assisted by E. F. Chandler, A. H. Tuttle, R. F. Edwards, and Lois H. Hershner, and by C. S. Heidel, State hydrographer for Montana.

Data relating to tributaries of Missouri River in Colorado, South Dakota, and Wyoming were collected and prepared for publication under the direction of Robert Follansbee, district engineer, who was assisted by S. B. Soulé, H. W. Fear, P. V. Hodges, H. K. Smith, and Miss Jane Hanna.

Data for two stations in the Yellowstone National Park were collected and prepared for publication under the direction of G. C. Baldwin, district engineer, who was assisted by C. G. Paulsen and E. Hazel Haugse.

Data for stations in Kansas were collected and prepared for publication by R. C. Rice, district engineer.

GAGING-STATION RECORDS.

MISSOURI RIVER PROPER.

RED ROCK CREEK BELOW RED ROCK RESERVOIR, NEAR MONIDA, MONT.

LOCATION.—In sec. 32, T. 13 S., R. 6 W., at weir 150 yards below reservoir of Red Rock Reservoir & Irrigation Co., 8 miles northeast of Monida and 15 miles east of Lima, in Beaverhead County.

DRAINAGE AREA.—560 square miles.

RECORDS AVAILABLE.—July 22, 1911, to September 30, 1917; also miscellaneous measurements made in summer of 1910.

GAGE.—Stage determined by measuring with graduated rod the depth on a peg in concrete well set with its top at elevation of crest of weir. Observations made by P. V. Maxwell. Float gage in concrete well used in 1912 and 1913. During 1911 a temporary vertical staff on left bank 300 yards below dam was read. Gage heights beginning with those for 1912 indicate head on crest of 40-foot weir 150 yards below dam.

DISCHARGE MEASUREMENTS.—Made from footbridge 40 feet above weir or by wading.

CHANNEL AND CONTROL.—Bed composed of coarse gravel, pebbles, and boulders. Banks high; right bank is subject to overflow only during extremely high water. Current so swift at high stages that channel above weir, if cleaned out, soon becomes partly filled with rocks and pebbles, which cause considerable velocity of approach. Stage-discharge relation seldom changes after natural deposit has been allowed to rest undisturbed.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.8 feet at 6 p. m. May 13 and 8 a. m. May 14 (discharge, 1,080 second-feet; minimum stage recorded, 0.66 foot August 28-31, and September 1-3 and 6-9 (discharge, 75 second-feet).

1911-1917: Maximum stage recorded, 3.2 feet April 28, 1914 (discharge, 1,220 second-feet); minimum stage recorded, 0.10 foot January 1 to April 10, 1913 (discharge, 5 second-feet).

ICE.—Stage-discharge seriously affected by ice; observations discontinued during winter.

DIVERSIONS.—None.

REGULATION.—Dam is used to store flood waters which are released as required during irrigating season.

ACCURACY.—Stage-discharge relation practically permanent both before and after weir was cleaned July 11–13, a change occurring at that time. Rating curve used to July 11 well defined between 200 and 500 second-feet; rating curve used after July 13 well defined. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating tables, except for July 11–13, when it was interpolated. Records good.

COOPERATION.—Record of daily gage height furnished by Red Rock Reservoir & Irrigation Co.

The following discharge measurement was made by C. S. Heidel:

October 5, 1916: Gage height, 1.20 feet; discharge, 230 second-feet.

Daily discharge, in second-feet, of Red Rock Creek below Red Rock reservoir, near Monida, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	252	200	....	775	955	234	111	75
2	252	200	....	787	943	234	102	75
3	241	200	....	804	943	200	102	75
4	234	207	....	847	931	200	102	78
5	234	207	....	925	919	200	102	78
6	234	191	....	955	919	200	92	75
7	234	178	....	955	907	200	92	75
8	234	166	....	955	907	200	92	75
9	234	158	....	955	895	200	92	75
10	234	141	....	955	895	200	82	77
11	234	....	....	967	895	176	82	78
12	234	....	....	1,000	895	152	82	78
13	234	....	....	1,050	895	128	82	80
14	234	....	....	1,020	895	104	84	78
15	303	....	106	955	895	104	82	78
16	436	....	106	967	895	104	82	78
17	548	....	110	969	883	124	82	78
18	631	....	158	973	835	147	82	78
19	659	....	203	979	835	147	78	78
20	659	....	210	979	835	142	82	78
21	659	....	214	979	570	142	82	78
22	659	....	234	985	522	142	82	78
23	631	....	260	985	496	142	82	78
24	631	....	267	967	470	133	82	78
25	659	....	337	979	445	124	82	78
26	659	....	465	955	445	124	78	78
27	659	....	581	955	436	122	78	78
28	659	....	671	955	422	122	75	78
29	631	....	746	955	422	122	75	78
30	548	....	775	955	422	115	75	82
31	376	....	....	955	....	115	75	....

NOTE.—May 4 to June 20, 1917, water passed around weir; estimated by observer as follows:

	Second-feet.		Second-feet
May 4	25	June 10-12	15
May 11-26	37	June 13-16	12
May 27 to June 4	25	June 17-20	7.5
June 5-9	20		

Monthly discharge of Red Rock Creek below Red Rock reservoir, near Monida, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	659	234	430	26,400
November 1-10	207	141	185	3,670
April 15-30	775	106	340	10,800
May	1,050	775	948	58,300
June	955	422	754	44,900
July	234	115	155	9,530
August	111	75	85.6	5,260
September	82	75	77.5	4,610

BEAVERHEAD RIVER AT BARRATTS, MONT.

LOCATION.—In SW. ¼ SW. ¼ sec. 20, T. 8 S., R. 9 W., at highway bridge at point where highway crosses railroad and where both highway and railroad bridges cross river, 1 mile above Barratts, in Beaverhead County, 2 miles below mouth of Grasshopper Creek, and 10 miles southwest of Dillon.

DRAINAGE.—Not measured.

RECORDS AVAILABLE.—August 12, 1907, to September 30, 1917.

GAGE.—Chain gage on downstream side of bridge; read twice daily by T. Masuno. Before June 22, 1908, a staff gage was used. Datum of chain gage same as that of staff gage.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Banks high, covered with brush, and not subject to overflow. Stream bed clean and rocky. Two channels at low and medium stages, caused by an old pier; sudden changes unlikely.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 5.70 feet at 7.45 a. m. May 16 (discharge, 3,200 second-feet); minimum stage 0.95 foot at 3.55 p. m. February 18 (discharge, 240 second-feet).

1907–1917: Maximum stage recorded, 6 feet June 19 and 20, 1908 (discharge, 3,640 second-feet); minimum stage recorded, 0.42 foot June 23, 1910 (discharge, 114 second-feet).

ICE.—Stage-discharge relation not affected by ice during 1917.

DIVERSIONS.—Numerous diversions are made above station. Water rights aggregating 85,866 inches of water are decreed from Lima on Red Rock Creek to a point 10 miles above Twin Bridges. The three largest canals diverting below the station are Canyon Creek canal, appropriating 6,000 inches; Union canal, appropriating 4,000 inches; and Beaverhead canal, diverting just north of Dillon, appropriating 5,000 inches. Union Electric Co. of Dillon has a canal with a carrying capacity of 6,000 inches.

REGULATION.—Operation of the dam on Red Rock Creek near Monida, used to store flood waters, has some effect on the flow at this station.

ACCURACY.—Stage-discharge relation not affected by ice or shifting control during year. Rating curve fairly well defined between 400 and 2,200 second-feet. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Beaverhead River is called Red Rock Creek from its source in Red Rock Lakes to Red Rock post office, below which it is called the Beaverhead. Principal tributaries of Beaverhead River above station are Grasshopper Creek, 12 miles south of Dillon; Horse Prairie Creek, 20 miles south; and Rattlesnake and Blacktail Deer creeks. Irrigation has probably been practiced in Beaverhead Valley longer than in any other valley in Montana, because ditches constructed in the early seventies are still in operation.

The following discharge measurement was made by C. S. Heidel:

October 3, 1916: Gage height, 1.65 feet; discharge, 532 second-feet.

Daily discharge, in second-feet, of Beaverhead River at Barratts, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	467	840	332	375	332	292	332	1,210	2,150	1,080	256	292
2	467	840	332	375	312	292	312	1,210	1,870	961	256	292
3	542	840	332	375	292	292	292	1,210	1,730	961	256	292
4	567	840	332	375	292	292	292	1,210	2,010	900	292	292
5	619	840	332	375	292	292	292	1,210	2,150	840	292	292
6	619	782	332	332	312	292	312	1,210	2,150	699	292	274
7	619	726	375	332	292	292	354	1,340	1,940	619	292	256
8	619	672	375	332	292	292	375	1,470	1,870	619	292	256
9	567	567	375	332	292	292	420	1,540	1,870	516	292	256
10	567	467	375	332	292	292	672	1,540	1,870	516	292	256
11	593	467	375	332	292	292	726	1,600	2,290	467	292	274
12	619	420	354	332	256	292	840	1,730	2,150	398	292	292
13	593	420	332	332	256	256	840	1,940	1,870	354	292	292
14	619	467	375	332	256	256	840	2,220	1,800	292	292	292
15	619	467	375	332	256	256	726	2,570	1,730	292	312	292
16	619	444	375	332	256	256	699	3,130	1,730	292	332	292
17	672	420	375	332	256	256	672	2,990	1,800	292	332	292
18	726	375	375	332	256	256	619	2,570	2,010	274	332	292
19	782	375	375	332	292	256	567	2,010	2,290	256	332	292
20	840	375	375	332	292	256	593	2,150	2,570	256	332	292
21	840	354	332	332	292	256	961	2,430	2,010	256	332	292
22	840	354	332	332	292	256	1,080	2,150	1,870	256	292	292
23	840	375	375	332	292	256	1,150	2,150	1,800	256	292	292
24	900	375	375	292	292	256	1,210	2,220	1,730	256	332	292
25	900	375	375	292	292	256	1,340	2,150	1,660	256	332	292
26	900	375	375	292	292	256	1,340	2,010	1,540	256	332	292
27	961	375	375	292	292	256	1,340	1,870	1,340	256	312	292
28	961	375	375	292	292	274	1,210	1,870	1,210	256	292	292
29	961	375	375	292	......	312	1,150	2,010	1,150	256	292	292
30	900	354	375	292	......	354	1,150	2,150	1,080	256	292	292
31	900	......	375	312	......	332	......	2,220	......	256	292	......

Monthly discharge of Beaverhead River at Barratts, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	961	467	717	44,100
November	840	354	511	30,400
December	375	332	362	22,300
January	375	292	329	20,200
February	332	256	286	15,900
March	354	256	278	17,100
April	1,340	292	757	45,000
May	3,130	1,210	1,910	117,000
June	2,570	1,080	1,840	109,000
July	1,080	256	442	27,200
August	332	256	301	18,500
September	292	256	286	17,000
The year	3,130	256	670	484,000

MISSOURI RIVER AT FORT BENTON, MONT.

Location.—In NE. ¼ sec. 26, T. 24 N., R. 8 E., on highway bridge at Fort Benton, Choteau County.

Drainage area.—24,600 square miles.

Records available.—July 1, 1902, to April 27, 1910, gage heights recorded by United States Weather Bureau; April 28, 1910, to September 30, 1917, United States Geological Survey records.

Gage.—Chain gage on upstream side of bridge installed July 30, 1917. Mott gage read April 11, 1907, to July 30, 1917. Gage heights for 1911–1917 are referred to datum used by United States Army Engineers from 1880–1890, which is 0.43 foot higher than that used by United States Geological Survey in 1910.

Channel and control.—Channel composed of coarse gravel and sand. Control is rock ledge covered with heavy boulders, located 1,000 feet below gage; may shift slightly.

Extremes of discharge.—Maximum stage recorded during year, 9.90 feet at 9 a. m. May 27 (discharge, 55,200 second-feet); minimum stage recorded, 0.36 foot, August 26 (discharge, 3,650 second-feet).

1881–1917: Maximum stage recorded, 9.90 feet May 27, 1917 (discharge, 55,200 second-feet); maximum stage recorded by United States Weather Bureau, 15.3 feet June 7, 1908 (discharge not computed); minimum open-water stage recorded, −0.2 foot September 10, 1914 (discharge, 2,250 second-feet); minimum stage recorded by United States Weather Bureau, −0.5 foot August 7–10, 17, and 18, 1910 (discharge not computed). Open-season records only; flow may have been lower during winter.

Ice.—Stage-discharge relation seriously affected by ice; December 13 to March 20, flow not computed.

Diversions.—Numerous diversions from tributaries.

Regulation.—Flow partly regulated by operation of storage reservoirs and power plants of Montana Power Co. above station.

Accuracy.—Stage-discharge relation affected by ice December 13 to March 21; otherwise permanent. Rating curve well defined above 2,050 second-feet. Gage read to hundredths twice daily; readings July 1–19 unreliable and were not used. Daily discharge ascertained by applying mean daily gage height to rating table. Records only fair October 14 to July 19 on account of trouble with Mott gage; good after July 20.

Discharge measurements of Missouri River at Fort Benton, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 14	A. H. Tuttle	1.22	6,470	July 30	A. H. Tuttle	1.06	5,270
June 25	.....do	8.45	44,800	Sept. 10	W. A. Lamb	.53	3,871

Daily discharge, in second-feet, of Missouri River at Fort Benton, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		6,700	4,750		15,500	17,500	51,000	40,700	6,000	3,750
2		6,700	4,750		15,000	17,000	50,300	39,400	6,000	3,750
3		6,350	4,750		15,000	17,000	51,000	37,400	6,000	3,750
4		6,350	4,750		15,000	16,000	50,300	36,200	6,000	3,750
5		6,350	4,750		15,000	14,000	49,600	34,300	5,650	3,750
6		6,350	4,750		16,500	14,000	46,800	32,500	6,000	4,000
7		6,000	5,000		19,000	14,000	46,100	31,300	6,000	4,000
8		5,300	5,000		19,600	19,000	42,600	29,500	5,650	4,000
9		5,300	5,300		19,600	24,700	44,700	28,300	5,650	4,000
10		5,000	5,300		19,000	25,900	45,400	26,500	5,650	4,000
11		4,750	5,650		18,500	26,500	46,100	24,700	5,650	4,000
12		4,250	6,000		18,000	27,100	46,800	23,500	5,650	4,000
13		4,250			17,500	28,900	47,500	21,200	5,650	4,000
14	6,000	4,250			14,500	31,300	51,000	20,100	5,300	4,000
15	6,000	4,250			14,000	36,200	51,000	18,000	5,000	4,000
16	5,650	4,250			14,500	42,000	50,300	16,500	5,000	4,000
17	5,650	4,250			14,000	39,400	51,000	15,000	4,750	4,500
18	5,650	4,250			14,000	39,400	48,900	13,500	4,750	4,750
19	5,650	4,250			13,500	40,700	48,900	12,000	3,750	5,000
20	6,000	4,500			12,000	41,400	48,900	10,400	3,750	5,000
21	6,600	4,500		13,500	9,600	41,400	48,900	10,000	3,750	5,300
22	6,000	4,500		12,500	12,500	42,000	48,200	9,200	3,750	5,300
23	6,000	4,500		12,500	18,500	42,000	47,500	9,200	3,750	5,300
24	6,000	4,500		12,500	19,000	41,400	44,700	8,800	3,750	5,650
25	6,000	4,500		11,200	20,100	39,400	44,700	8,450	3,750	6,000
26	6,350	4,500		10,800	19,000	54,500	43,300	7,750	3,750	6,000
27	6,350	4,500		11,600	19,000	55,200	42,600	7,400	3,750	6,350
28	6,700	4,500		13,000	18,000	53,100	42,000	7,050	3,750	6,350
29	6,700	4,500		14,500	18,000	53,100	42,000	6,000	3,750	6,700
30	6,700	4,750		16,500	18,000	52,400	42,000	6,000	3,750	7,050
31	6,700			18,000		52,400		6,000	3,750	

NOTE.—Stage-discharge relation seriously affected by ice; flow not computed Dec. 13 to Mar. 20, although gage-height record is continuous for period. No readings Oct. 1-13; flow not computed. Gage-height records July 1-19 discarded owing to errors in observer's readings; discharge interpolated for period.

Monthly discharge of Missouri River at Fort Benton, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October 14-31	6,700	5,650	6,120	219,000
November	6,700	4,250	4,960	295,000
December 1-12	6,000	4,750	5,060	120,000
March 21-31	18,000	10,800	13,300	290,000
April	20,100	9,600	16,400	976,000
May	55,200	14,000	34,200	2,100,000
June	51,000	42,000	47,100	2,800,000
July	40,700	6,000	19,300	1,190,000
August	6,000	3,750	4,810	296,000
September	7,050	3,750	4,730	281,000

MADISON RIVER BASIN.

MADISON RIVER NEAR YELLOWSTONE, MONT.

LOCATION.—Approximately in sec. 5, T. 14 S., R. 6 E. Montana meridian, 250 feet downstream from old footbridge at fording place of old Gallatin trail 300 feet north of stage road to Yellowstone, almost directly in front of Riverside soldier station, and 4 miles east of Yellowstone and west boundary of Yellowstone National Park. Gibbon and Firehole rivers unite to form the Madison 8 miles upstream.

DRAINAGE AREA.—410 square miles (measured on topographic maps).

RECORDS AVAILABLE.—June 16, 1913, to September 30, 1917.

GAGE.—Vertical staff on left bank; read by Chas. A. Smith and other soldiers attached to Riverside soldier station.

DISCHARGE MEASUREMENTS.—High-stage measurements made from cable one-third mile below gage, installed September 9, 1917. Previous to this date high-stage measurements made from old footbridge 250 feet upstream from gage. Medium and low stage measurements made by wading at gage.

CHANNEL AND CONTROL.—One channel at all stages. Bed of stream is gravel and boulders; somewhat rough; control is probably permanent. Aquatic growth is present during greater part of year and during summer affects the stage-discharge relation.

ICE.—Stage-discharge relation not seriously affected by ice. Temperature of water except during extremely cold weather kept above freezing point by numerous hot springs and geysers.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.64 feet at 6 p. m. June 10 (discharge, 1,950 second-feet); minimum stage recorded 1.30 feet at 4 p. m., January 22 (discharge, 420 second-feet).

1913–1917: Maximum stage recorded, 2.64 feet at 6 p. m. June 10, 1917 (discharge, 1,950 second-feet); minimum stage recorded, 1.25 feet July 21–25, 1915 (discharge, 370 second-feet).

DIVERSIONS.—None above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically constant during year, except during August and September, when it was affected by aquatic growth. Two fairly well defined rating curves used, one applicable October 1 to July 31; the other August 17 to September 30. Shifting-control methods used August 1–16. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records only fair, chiefly on account of unstable condition of gage during most of the year.

Discharge measurements of Madison River near Yellowstone, Mont., during the year ending Sept. 30, 1917.

[Made by G. C. Baldwin.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 28	2.22	1,450
Sept. 9	1.42	495

Daily discharge, in second-feet, of Madison River near Yellowstone, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	522	522	471	522	471	522	563	502	1,070	1,300	642	497
2	522	522	522	522	522	522	568	502	1,020	1,300	638	497
3	522	574	522	522	548	522	563	440	980	1,190	634	497
4	420	522	522	522	574	522	615	440	930	1,190	630	497
5	574	522	522	522	625	522	612	440	880	1,190	625	497
6	574	522	522	522	574	522	608	440	832	1,190	621	579
7	728	522	522	522	548	522	604	481	780	1,070	617	579
8	625	522	522	522	522	522	656	481	780	1,070	613	497
9	574	522	522	522	471	522	707	532	1,360	961	518	497
10	574	574	522	522	471	522	646	532	1,950	961	515	497
11	574	522	522	522	522	574	646	635	1,450	961	513	497
12	574	471	522	471	522	574	594	625	1,220	853	510	497
13	522	471	522	471	522	522	543	780	983	853	507	497
14	522	471	522	471	522	522	512	832	972	853	505	535
15	522	522	522	471	522	522	481	994	1,260	749	502	535
16	522	522	522	471	522	522	481	1,040	1,560	749	500	535
17	522	522	522	471	471	522	481	1,150	1,560	749	579	497
18	676	522	522	471	522	522	481	1,120	1,570	749	579	497
19	574	522	522	471	522	522	471	1,100	1,570	479	579	497
20	574	471	522	471	522	522	471	1,210	1,580	749	497	497
21	574	471	522	471	522	522	471	1,030	1,580	749	497	497
22	625	471	522	420	522	574	471	1,080	1,590	749	497	497
23	522	471	522	471	522	548	574	1,200	1,600	646	497	535
24	574	471	522	488	522	522	563	1,140	1,600	646	497	535
25	574	471	522	505	522	522	563	1,190	1,610	646	497	579
26	574	522	522	522	522	522	563	1,190	1,420	646	497	535
27	574	522	522	522	522	574	512	1,190	1,420	646	497	497
28	574	522	522	574	522	600	492	1,250	1,400	646	497	497
29	574	522	522	522	....	625	472	1,360	1,420	646	497	497
30	522	522	522	522	....	574	451	1,410	1,420	646	497	497
31	522	....	522	471	....	574	....	1,120	....	646	497	....

NOTE.—Discharge interpolated Dec. 8-10, 14, 23, 25; Jan. 1-5, 16-20, 24-25; Feb. 3, 7, 15, 26; Mar. 3, 9, 16, 23, 28; Apr. 5-6, 8, 12, 14, 16, 20-21, 28-29; May 18; June 1-5, 9, 12, 17-23; and Aug. 10.

Monthly discharge of Madison River near Yellowstone, Mont., for the year ending Sept. 30, 1917.

[Drainage area, 410 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches.	Total in acre-feet.
October	728	522	562	1.37	1.58	34,600
November	574	471	510	1.24	1.38	30,300
December	522	471	520	1.27	1.46	32,000
January	574	420	499	1.22	1.41	30,700
February	625	471	524	1.28	1.33	29,100
March	625	522	539	1.31	1.51	33,100
April	707	451	548	1.34	1.50	32,600
May	1,410	440	885	2.16	2.49	54,400
June	1,950	780	1,310	3.20	3.57	78,000
July	1,300	646	863	2.10	2.42	53,100
August	642	497	542	1.32	1.52	33,300
September	579	497	513	1.25	1.40	30,500
The year	1,950	420	652	1.59	21.6	472,000

PRICKLY PEAR CREEK BASIN.

TENMILE CREEK NEAR RIMINI, MONT.

LOCATION.—In NE. ¼ sec. 20, T. 9 N., R. 5 W., opposite Moose Creek ranger station, 500 feet above mouth of Moose Creek, and 3 miles north of Rimini, in Lewis and Clark County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—March 13, 1915, to September 30, 1917.

GAGE.—Friez water-stage recorder on left bank opposite ranger station; observer, D. H. Lewis, a forest ranger.

DISCHARGE MEASUREMENTS.—Made by wading just below gage.

CONTROL.—Gravel and boulders; slightly shifting. Left bank high and steep; composed of loose material; will not be overflowed but will erode. Right bank sloping and subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 4.87 feet at 2 p. m., May 15 (discharge, 948 second-feet); minimum stage recorded, 1.28 feet at 6 p. m., October 10, 1916 (discharge, 1.4 second-feet).

1915–1917: Maximum stage recorded, 4.87 feet at 2 p. m., May 15, 1917 (discharge, 948 second-feet); minimum stage, 1.28 feet at 6 p. m., October 10, 1916 (discharge, 1.4 second-feet).

ICE.—Stage-discharge relation affected very little, if any, by ice; open-channel conditions assumed.

DIVERSIONS.—Small ditch diverts in summer for water supply of Helena.

REGULATION.—Small reservoir of water supply system of Helena is above station, but operation of reservoir has probably little, if any, effect upon the flow past gaging station.

ACCURACY.—Stage-discharge relation changed during year. Fairly well defined rating curves used for short periods. Water-stage recorder did not operate satisfactorily, except for short periods in October, November, April, and May. After January 2 staff gage was read to hundredths once daily, except for periods indicated in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage height determined from recorder graph, or daily reading from staff gage. Records fair.

Discharge measurements of Tenmile Creek near Rimini, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 11	W. A. Lamb	1.45	6.8	May 8	W. A. Lamb	2.80	101
15	.....do	1.64	7.7	10	Lamb and Heidel	3.07	136
Dec. 7	.....do	1.50	5.4	25	W. A. Lamb	4.23	596
Jan. 2	.....do	1.47	5.2	31	.....do	3.60	278
Feb. 3	A. H. Tuttle	1.36	3.7	July 21	A. H. Tuttle	1.91	15.3
Mar. 17	.....do	1.35	4.1	Aug. 25	W. A. Lamb	1.47	2.0
May 1	W. A. Lamb	2.18	29.1	Sept. 24	Tuttle and Lamb	1.70	6.0

NOTE.—Nov. 11, 15; Dec. 7; Jan. 2; Feb. 3; amd Mar. 17, ice present. Stage-discharge relation apparently not affected.

Daily discharge, in second-feet, of Tenmile Creek near Rimini, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	5.1	10	5.5	4.4	3.8	4.4	23	257	85	7.5	4.2
2	4.5	10	5.2	3.9	3.8	4.2	30	232	72	7.5	4.2
3	4.0	11	5.0	3.8	3.8	4.2	32	204	64	7.5	4.4
4	5.1	13	4.8	4.0	3.8	4.2	31	191	59	7.5	4.6
5	5.1	13	4.7	4.0	3.8	4.7	39	204	54	7.0	4.6
6	5.7	11	4.6	4.0	3.8	4.6	49	217	49	6.8	4.6
7	5.7	11	4.4	4.0	3.8	4.9	76	310	35	6.5	4.6
8	4.9	11	5.3	3.8	3.8	8.2	104	354	33	6.0	4.6
9	3.0	12	4.7	3.8	3.8	7.8	106	417	33	5.6	4.6
10	3.8	9.0	4.8	4.0	3.9	10	130	392	33	5.2	4.6
11	6.3	6.5	4.7	3.8	3.8	13	150	331	28	4.8	4.6
12	6.5	6.7	4.6	3.9	4.0	13	199	258	25	4.4	4.6
13	7.4	7.1	4.6	3.8	4.0	13	290	288	23	4.2	4.6
14	7.2	7.6	4.6	3.8	4.0	12	569	264	22	4.0	4.6
15	....	8.1	4.6	4.0	4.0	9.0	811	322	19	3.8	4.6
16	....	8.1	4.8	3.8	4.0	9.5	600	402	19	3.7	7.2
17	....	8.1	5.0	4.7	4.1	9.0	430	444	17	7.2	7.2
18	....	8.1	5.8	4.4	4.0	9.0	390	344	13	3.2	7.2
19	....	....	4.2	4.5	4.0	9.0	400	272	11	3.0	7.2
20	....	....	4.3	4.7	4.0	12	380	264	12	2.3	7.2
21	....	....	4.1	4.5	4.0	24	370	226	16	1.9	7.2
22	....	....	4.0	4.0	4.0	25	360	204	13	1.9	7.2
23	....	....	3.8	3.8	4.0	31	340	180	12	1.9	15
24	....	....	3.9	3.8	4.0	33	440	191	11	1.7	15
25	....	....	3.9	3.8	3.9	35	506	158	11	1.7	6.7
26	....	....	3.9	3.8	3.9	32	780	130	10	1.7	6.7
27	....	....	4.0	3.6	4.3	35	800	122	9.8	3.2	6.7
28	....	....	4.0	3.8	4.8	38	700	106	8.8	3.7	6.2
29	....	....	4.0	....	5.4	20	540	99	8.2	3.7	6.2
30	....	....	3.9	....	4.7	19	420	92	8.0	3.8	6.2
31	....	....	4.0	....	4.5	....	282	....	8.0	4.0	....

NOTE.—Water-stage recorder was in operation Oct. 1-14, Nov. 1-12, 15-18, Apr. 22 to May 6, and May 8-15; no records Oct. 15-31, Nov. 19-30, Dec. 1-6 and 8-31; discharge for other periods determined from records from staff gage, except for the following periods for which it was interpolated: Nov. 13, 14; Jan. 1, 3-16, 21, 22, Mar. 24, 25, 28, 31; Apr. 1, 10; May 7, 16-24, and 26-30.

Monthly discharge of Tenmile Creek near Rimini, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October 1-14	7.4	3.0	5.31	147
November 1-18	13	6.5	9.52	340
January	5.8	3.8	4.51	277
February	4.7	3.8	4.01	223
March	5.4	3.8	4.06	249
April	38	4.2	15.3	910
May	811	23	338	20,800
June	444	92	248	14,800
July	85	8.0	26.5	1,630
August	7.5	1.7	4.42	272
September	15	4.2	6.24	371

TENMILE CREEK NEAR HELENA, MONT.

LOCATION.—In SW. ¼ SE. ¼ sec. 22, T. 10 N., R. 4 W., opposite Broadwater Hotel, near Helena, in Lewis and Clark County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—July 8, 1908, to September 30, 1917.

GAGE.—Staff on right bank; read by J. W. Jackson.

DISCHARGE MEASUREMENTS.—Made by wading, or from highway bridge 500 feet below gage.

CHANNEL AND CONTROL.—Bed of stream composed of coarse gravel and boulders; shifting occasionally.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.60 feet at 6.30 p. m. May 28 (discharge, 865 second-feet); minimum stage recorded, 1.75 feet August 24–28 (discharge, 2.3 second-feet).

1908–1917: Maximum stage recorded, 5.60 feet at 6.30 p. m. May 28, 1917 (discharge, 865 second-feet); minimum stage recorded, 1.15 feet August 5 to September 10, 1910 (discharge, 0.15 second-foot).

ICE.—Stage-discharge relation slightly affected by ice. For flow during period, see note to table of daily discharge.

DIVERSIONS.—Part of water supply for city of Helena is taken from Tenmile Creek above station. Two irrigation ditches also take water from the creek above gage. The entire low-water flow is appropriated and used before it reaches the mouth of the creek.

REGULATION.—None.

ACCURACY.—Stage-discharge relation affected by shifting control; very little, if any, by ice effect. Rating curve used October 1 to May 31 fairly well defined between 10 and 700 second-feet; indirect method used June 1 to September 30. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good October to December and March 15 to May 31; fair for rest of year.

Discharge measurements of Tenmile Creek, near Helena, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 2	W. A. Lamb	1.94	7.9	May 11	W. A. Lamb	3.72	228
Feb. 7	Tuttle and Lamb	1.83	5.6	26	do	5.2	708
Mar. 20	Lamb and Anderson	1.77	5.8	June 24	do	[a] 3.72	148
May 2	W. A. Lamb	2.68	58	Aug. 25	do	1.76	2.3

[a] Mean gage height for day from observer's record.

Daily discharge, in second-feet, of Tenmile Creek near Helena, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	13	18	13	7.5	5		19	60	552	68	4.0	2.6
2	15	18	13	7.5	5		15	60	530	57	4.0	2.6
3	15	18	13	9	5		19	60	517	45	4.0	2.6
4	15	18	10.5	9	5.3		25	55	500	43	3.5	2.6
5	15	13	10.5	9	5.6		26	55	486	39	3.6	2.6
6	15	10	10.5	9	5.6		50	73	473	35	3.9	2.7
7	18	10	10.5	9	5.6		52	104	470	35	4.2	2.9
8	18	9.0	10.5	7	5.6		69	104	520	32	4.9	2.9
9	18	9	10.5	7			60	136	555	32	4.3	3.4
10	18	9	10.5	7			58	193	541	30	4.3	3.4
11	20	7.5	10.5	7			52	237	457	29	4.3	3.9
12	20	7.5	10.5	7			52	275	428	25	4.3	3.9
13	20	6.5	10.5	7			52	406	413	26	3.8	3.9
14	23	7.5	10.5	7			50	665	367	18	3.8	3.9
15	23	10.5	10.5	7			41	745	325	18	3.8	4.6
16	23	10.5	10.5	6		5.5	41	793	320	15	3.8	4.6
17	23	13	10.5	6		5.5	30	590	314	13	3.8	4.9
18	30	13	10.5	5		5.8	30	428	295	11	3.9	4.9
19	30	15	10.5	5		5.8	26	416	262	9.9	3.6	6.3
20	26	15	10	6		5.8	35	422	244	9.6	3.4	6.3
21	26	15	10	7		5.8	41	406	216	9.0	2.9	6.7
22	26	13	10	7		5.5	48	397	187	8.1	2.6	7.3
23	26	13	10	7		5.5	60	367	167	7.3	2.6	7.8
24	26	13	10	7		5.5	71	397	149	6.1	2.3	8.7
25	23	13	10	7		5.5	73	422	128	5.2	2.3	9.3
26	23	13	10	7		5.5	77	572	128	4.9	2.3	10.2
27	23	13	9	7		13	71	697	109	4.4	2.3	11
28	23	13	9	7		18	71	845	98	4.2	2.3	12
29	23	13	9	6		50	62	705	91	3.9	2.4	11
30	23	13	9	5		145	62	583	82	3.9	2.6	10.2
31	20		9	5		71		538		3.9	2.6	

NOTE.—Stage-discharge relation affected by ice Dec. 20–25, Jan. 8–31, Feb. 1–Mar. 21. Discharge, Feb. 9 to Mar. 15 estimated as 5.0 second-feet.

Monthly discharge of Tenmile Creek near Helena, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	30	13	21.3	1,310
November	18	6.5	12.3	732
December	13	9	10.4	640
January	9	5	6.97	429
February	5.6	5.0	5.10	283
March	145	5.0	14.0	861
April	77	15	47.9	2,850
May	845	55	381	23,400
June	555	82	331	19,700
July	68	3.9	21.0	1,290
August	4.9	2.3	3.43	211
September	12	2.6	5.64	336
The year	845	2.3	71.9	52,000

LITTLE PRICKLY PEAR CREEK BASIN.

LITTLE PRICKLY PEAR CREEK NEAR MARYSVILLE, MONT.

LOCATION.—At highway bridge on ranch of Casper Traufer, about a quarter of a mile below mouth of Deadman Creek and 6 miles northwest of Marysville, in Lewis and Clark County.

DRAINAGE AREA.—49 square miles (measured on topographic map).

RECORDS AVAILABLE.—May 24, 1913, to September 30, 1917, at present site; April 12, to May 23, 1913, a quarter of a mile above present site; May 18, 1909, to December 31, 1911, at station formerly maintained above mouth of Deadman Creek.

GAGE.—Vertical staff spiked to upstream side of left abutment of highway bridge; read by Casper Traufer. April 12 to May 23, 1913, vertical staff a quarter of a mile above present site; washed out by high water and replaced by present gage at different datum; discharge practically the same at the two points. Gage used May 18, 1909, to December 31, 1911, was a vertical staff on downstream side of Mr. Pearce's private bridge, half a mile above mouth of Deadman Creek.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading at bridge.

CHANNEL AND CONTROL.—Sand and gravel; shifts slightly.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.8 feet May 25 and 26 (discharge, 454 second-feet); minimum discharge, 7.5 second-feet, September 23 and 24.

1909–1911 and 1913–1917: Maximum stage recorded, 3.8 feet May 25 and 26, 1917 (discharge, 454 second-feet); minimum stage, 2.28 feet (old gage) March 7–13, 1911 (discharge, 1.2 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

DIVERSIONS.—Numerous small ditches divert water from the stream, practically the entire normal flow being appropriated.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by shifting control and occasionally by ice. Rating curve used October 1 to June 10 well defined between 15 and 340 second-feet; curve used July 28 to September 30 poorly defined; shifting-control method used June 11 to July 27. Gage read to half-tenths twice daily. Daily discharge obtained by applying mean daily gage height to rating table.

Discharge measurements of Little Prickly Pear Creek near Marysville, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 2	3.28	338
July 28	1.65	35.3

Daily discharge, in second-feet, of Little Prickly Pear Creek near Marysville, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	19	13	10.5	8	22	312	118	31	16
2	19	13	10.5	8	22	332	105	31	16
3	19	13	10.5	8	22	326	100	31	16
4	19	13	10.5	8	22	318	96	31	16
5	19	13	10.5	8	25	292	90	31	16
6	19	13	10.5	8	28	282	87	31	16
7	19	13	10.5	8	35	282	83	31	13
8	19	13	8	8	42	312	78	31	13
9	19	13	8	9	49	354	74	31	10
10	19	13	8	13	66	354	71	31	10
11	19	10.5	8	19	82	330	67	31	10
12	19	10.5	8	22	108	288	64	27	10
13	19	10.5	8	22	132	256	62	27	10
14	16	10.5	8	22	182	248	59	27	10
15	16	10.5	8	20	278	248	55	23	10
16	16	10.5	8	19	313	255	55	23	10
17	16	10.5	8	19	272	257	52	23	10
18	16	10.5	8	16	217	244	49	23	10
19	16	10.5	8	16	205	233	45	23	10
20	16	10.5	8	18	226	219	43	23	10
21	16	10.5	8	22	254	205	42	23	10
22	16	10.5	8	28	235	193	42	23	10
23	16	10.5	8	33	205	186	41	23	7.5
24	16	10.5	8	30	208	177	40	23	7.5
25	16	10.5	8	30	397	162	40	23	10
26	16	10.5	8	30	436	155	40	23	10
27	16	10.5	8	26	390	143	40	23	10
28	16	10.5	8	26	364	140	36	16	10
29	13	10.5	8	26	364	126	36	16	10
30	13	10.5	8	22	347	122	36	16	10
31	13	....	8	....	322	....	36	16	....

Monthly discharge of Little Prickly Pear Creek near Marysville, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	19	13	17.0	1,050
November	13	10.5	11.3	672
December	10.5	8.0	8.56	526
April	33	8	18.4	1,090
May	436	22	190	11,700
June	354	122	245	14,600
July	118	36	60.7	3,730
August	31	16	25.3	1,560
September	16	7.5	11.2	666

LITTLE PRICKLY PEAR CREEK NEAR CANYON CREEK, MONT.

Location.—In NW. ¼ sec. 9, T. 12 N., R. 5 W., near ford on Carbis ranch, below mouth of Canyon Creek, and 1¼ miles from Canyon Creek post office, in Lewis and Clark County.

Drainage area.—180 square miles (measured on topographic map).

Records available.—April 1, 1909, to December 31, 1911; and April 12, 1913, to September 30, 1917.

Gage.—Vertical staff attached to tree on right bank about 40 feet above ford; gage installed June 2, 1917, at independent datum, to replace the one washed out May 13; read by Melville Carbis.

Discharge measurements.—Made by wading near gage, or from wagon bridge 300 feet above gage.

Channel and control.—Sand and gravel; shifting. Banks overgrown with brush.

Extremes of discharge.—Maximum discharge recorded during year, 534 second-feet June 3–5; minimum stage, 0.50 foot July 28–31 and August 3–5 (discharge, 6.5 second-feet).

1909–1911 and 1913–1917: Maximum stage recorded, 4.8 feet May 29, 1913 (discharge, 665 second-feet); creek reported dry June 21–28, July 1–9, 21–22, August 1–2, 1910; July 22–27, 29, and 31, 1911.

Ice.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

Diversions.—Many small ditches divert from the stream; low-water flow practically all appropriated.

Regulation.—None.

Accuracy.—Stage-discharge relation permanent during year but a change of datum was made June 2 when new gage was installed. Rating curve well defined between 10 and 350 second-feet. Records good.

Discharge measurements of Little Prickly Pear Creek near Canyon Creek, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge
	Feet.	*Sec.-ft.*
June 2	3.64	400
July 28	.49	6.2

Daily discharge, in second-feet, of Little Prickly Pear Creek near Canyon Creek, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	34	42	42	....	137	....	30	8.5	16
2	42	42	42	....	145	496	30	8.5	16
3	46	46	34	....	153	534	30	6.5	16
4	46	46	34	....	170	534	30	6.5	16
5	42	51	38	....	179	534	30	6.5	20
6	42	51	38	....	188	510	34	8.5	20
7	51	46	27	....	217	510	34	8.5	20
8	51	42	27	....	207	486	30	10.5	23
9	51	51	27	....	217	463	30	10.5	23
10	46	51	21	....	248	440	30	10.5	23
11	46	51	30	....	296	440	26	10.5	23
12	42	46	34	....	440	417	26	10.5	23
13	42	42	34	....	....	452	26	10.5	23
14	42	42	34	....	....	350	23	10.5	23
15	38	38	34	60	....	350	23	13	23
16	34	38	42	60	....	350	23	13	23
17	34	34	42	60	....	350	23	13	23
18	42	34	46	51	....	328	20	13	23
19	42	34	46	60	....	306	20	16	26
20	46	27	42	122	....	285	16	16	26
21	51	30	42	137	....	265	16	16	30
22	51	30	38	137	....	246	16	16	30
23	51	27	38	122	....	227	16	16	30
24	42	27	....	107	....	209	10.5	20	30
25	33	34	....	122	....	191	10.5	20	38
26	34	34	....	122	....	174	8.5	23	46
27	42	38	....	137	....	174	8.5	23	46
28	51	38	....	137	....	158	6.5	23	46
29	51	42	....	122	....	142	6.5	23	46
30	51	38	....	122	....	127	6.5	20	46
31	42	....			....	....	6.5	20	....

Monthly discharge of Little Prickly Pear Creek near Canyon Creek, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	51	34	44.0	2,710
November	51	27	39.7	2,360
December 1-23	46	21	36.2	1,650
April 15-30	137	51	105	3,330
May 1-12	440	137	216	5,140
June	534	127	335	19,900
July	34	6.5	20.8	1,280
August	23	6.5	13.9	855
September	46	16	27.2	1,620

SUN RIVER BASIN.

NORTH FORK OF SUN RIVER NEAR AUGUSTA, MONT.

Location.—In sec. 36, T. 22 N., R. 9 W. (unsurveyed), at Sun River diversion dam, 18 miles northwest of Augusta, in Lewis and Clark County.

Drainage area.—Not measured.

Records available.—January 1, 1916, to September 30, 1917, at present site. From August 5, 1889, to December 31, 1890, and October 31, 1903, to December 31, 1915, a station in sec. 33, T. 22 N., R. 7 W., at the Henningson ranch, 8 miles downstream from present site. The flow is practically the same at both points, there being no large intervening tributaries entering and no diversions.

GAGE.—A sloping staff gage on right abutment of the Sun River diversion dam; read twice daily by employees of United States Reclamation Service. From October 31, 1903, to December 31, 1915, an overhanging chain gage was on left bank below ranch buildings of the Henningson Co. From August 5, 1889, to December 31, 1890, the gage was also near this point.

DISCHARGE MEASUREMENTS.—Made from footbridge at siphon half a mile below gage.

CHANNEL AND CONTROL.—Control is crest of Sun River diversion dam—a concrete structure with an arch section 153.3 feet long, and a gravity section 59.2 feet long, separated by a pier.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.2 feet at 6 p. m. May 25 (discharge, 18,700 second-feet); minimum stage recorded, 0.23 foot April 2 (discharge, 64 second-feet).

ICE.—Stage-discharge relation not affected by ice during year.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

The following discharge measurement was made by W. A. Lamb:

May 13, 1917: Gage height, 2.92 feet; discharge, 3,380 second-feet.

Daily discharge, in second-feet, of North Fork of Sun River near Augusta, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	461	372	332	217	217	184	124	254	4,630	3,780	825	204
2	461	372	332	217	217	184	64	254	5,000	3,920	557	204
3	461	372	332	217	217	184	113	291	4,270	4,230	528	184
4	461	372	291	217	217	184	132	332	4,020	4,190	538	184
5	461	332	291	217	217	184	152	372	3,720	4,060	509	184
6	461	332	291	217	217	152	152	461	3,820	4,060	461	184
7	416	332	217	184	217	152	184	557	4,940	3,980	443	372
8	416	332	254	184	254	184	217	944	6,300	3,520	461	372
9	416	372	254	184	254	184	291	1,320	9,210	3,310	416	372
10	372	372	254	217	254	152	291	1,760	7,830	3,320	416	152
11	372	372	291	217	254	152	332	2,240	5,700	2,950	372	152
12	372	372	291	217	254	152	372	3,230	4,450	2,660	372	152
13	372	372	291	217	291	152	372	3,660	3,920	2,420	356	152
14	372	372	291	217	291	152	291	5,350	4,230	2,080	332	152
15	372	372	254	217	254	152	291	6,800	5,820	1,900	332	152
16	372	372	254	184	254	152	291	8,650	7,900	1,710	509	152
17	372	372	254	184	254	184	254	4,890	9,790	1,680	509	107
18	372	372	254	184	254	184	254	4,120	8,650	1,530	490	107
19	372	372	254	217	217	152	254	4,020	7,570	1,420	291	107
20	372	372	254	217	217	152	291	4,670	7,000	1,320	291	96
21	372	372	254	217	217	124	291	4,670	6,680	1,230	254	96
22	372	372	291	217	217	124	332	4,020	5,870	1,100	217	96
23	372	372	291	184	184	124	332	4,120	5,300	980	217	96
24	372	372	291	217	184	124	332	3,820	5,350	944	217	172
25	372	372	254	217	184	124	332	12,500	4,890	871	217	158
26	372	332	254	217	184	107	332	15,500	4,890	813	184	152
27	372	332	254	217	184	107	332	8,930	4,630	756	184	124
28	372	332	254	217	217	124	372	7,700	4,710	713	184	107
29	372	332	217	184	....	152	372	8,240	5,000	659	184	107
30	372	332	217	184	....	152	291	6,060	4,230	756	184	107
31	372	....	217	184	....	152	....	4,890	....	825	204	....

Monthly discharge of North Fork of Sun River near Augusta, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	461	372	393	24,200
November	372	332	360	21,400
December	332	217	269	16,500
January	217	184	206	12,700
February	291	184	228	12,700
March	184	107	153	9,410
April	372	64	268	15,900
May	15,500	254	4,340	267,000
June	9,790	3,720	5,680	338,000
July	4,230	659	2,180	134,000
August	825	184	363	22,300
September	372	96	165	9,820
The year	15,500	64	1,220	884,000

SUN RIVER AT FORT SHAW, MONT.

LOCATION.—In SW. ¼ sec. 1, T. 20 N., R. 2 W., at highway bridge at Fort Shaw, Cascade County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 16, 1912, to September 30, 1917, A station on Sun River at Sun River, maintained July 31, 1905, to December 31, 1912, gave records for practically the same drainage area.

GAGE.—Chain gage at highway bridge read since November 24, 1916, by C. G. Peterson, an employee of the United States Reclamation Service; stage prior to September 1, 1913, measured by standard chain gage fastened to footbridge near right bank and 1,000 feet downstream. Staff gage September 1, 1913, to November 23, 1916, on right bank 400 feet above highway bridge. The three gages referred to different datums.

DISCHARGE MEASUREMENTS.—Made from highway bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and rock; fairly permanent; shifting only at extremely high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.3 feet at 10.15 a. m. May 26 (discharge, 17,600 second-feet); minimum stage recorded, 4.70 feet December 5 (discharge, 265 second-feet); lower minimum probably occurred during frozen season.

1905–1917: Maximum stage recorded, 13.4 feet June 7, 1908 (discharge, 18,400 second-feet); minimum stage recorded at Sun River, 1.3 feet September 14, 1906 (discharge, 47 second-feet); at Fort Shaw, 1.65 feet August 5, 6, and 8, 1914 (discharge, 95 second-feet). The high-stage discharge at Fort Shaw and Sun River is practically the same but at low stages the operation of Sun River canal (capacity about 50 second-feet), which takes out between the stations, may cause a material difference.

ICE.—Stage-discharge relation affected by ice November 12–18, 28, and December 5. Flow estimated for first period, and interpolated for others. Gage-height record continuous but discharge not computed December 10 to March 31.

DIVERSIONS.—Adjudicated rights for diverting 248 second-feet from Sun River direct and 664 second-feet from tributaries above this station. In addition, the Fort Shaw canal of the United States Reclamation Service takes out about 200 second-feet during irrigation season.

REGULATION.—Willow Creek reservior has a capacity of 84,200 acre-feet.

ACCURACY.—Rating curve well defined below 1,500 second-feet; used October 1 to December 9, except during ice-affected period. Curve fairly well defined between 470 and 8,760 second-feet; used April 1 to September 30. Gage read to half-tenths twice daily. Daily discharge obtained by applying mean daily gage height to rating table. Open-water records good; records for periods of ice effect fair.

Discharge measurements of Sun River at Fort Shaw, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Nov. 6	1.70	590	June 7	8.10	5,900	July 24	5.27	922
May 13	7.46	4,520	19	9.50	8,790	Sept. 17	4.45	451
22	7.89	5,510	July 3	7.44	4,230			

NOTE.—Gage height for measurement of Nov. 6, from old staff gage 400 feet above present chain gage. Later measurements referred to chain gage.

Daily discharge, in second-feet, of Sun River at Fort Shaw, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	985	590	365	852	852	7,490	4,180	680	410
2	985	590	365	745	852	6,960	4,080	540	410
3	1,050	590	365	650	890	6,230	4,180	430	410
4	985	590	365	620	890	5,700	4,180	492	410
5	782	590	365	852	890	5,390	4,180	492	410
6	652	590	365	1,060	890	5,080	4,180	450	410
7	782	590	365	815	1,060	5,600	3,980	450	450
8	985	590	365	815	1,460	6,760	3,780	492	540
9	985	590	265	890	1,810	8,330	3,480	565	450
10	918	590	....	815	2,130	9,200	3,390	515	410
11	850	590	....	680	2,650	8,120	3,200	540	410
12	715	590	....	780	3,390	6,650	2,830	540	390
13	652	590	....	815	4,280	5,500	2,650	492	372
14	590	590	....	745	5,500	5,280	2,300	470	430
15	590	590	....	712	6,650	6,120	1,970	450	410
16	590	590	....	680	7,910	7,800	1,970	540	410
17	590	715	....	620	6,340	9,420	1,740	592	410
18	590	652	....	650	4,980	9,420	1,660	515	430
19	590	590	....	650	4,580	8,330	1,460	450	450
20	590	590	....	712	5,180	7,700	1,390	372	442
21	590	590	....	890	6,120	7,380	1,160	372	442
22	590	590	....	930	5,390	6,650	970	372	453
23	590	474	....	930	4,780	6,120	970	390	450
24	590	590	....	1,110	4,380	5,810	890	372	582
25	590	365	....	970	8,760	5,700	890	372	638
26	590	474	....	970	15,400	5,280	745	372	540
27	590	365	....	1,060	11,000	4,980	712	390	492
28	590	478	....	1,020	9,640	5,080	620	410	484
29	590	590	....	890	11,000	5,080	620	410	484
30	590	474	....	890	8,540	4,780	540	430	470
31	590	....	....	....	7,490	....	620	410	....

Monthly discharge of Sun River at Fort Shaw, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	1,050	590	708	43,500
November	715	365	566	33,700
December 1-9	365	265	354	6,320
April	1,110	620	827	49,200
May	15,400	852	5,020	309,000
June	9,420	4,780	6,600	393,000
July	4,180	540	2,240	138,000
August	680	372	463	28,500
September	638	372	450	26,800

WILLOW CREEK NEAR AUGUSTA, MONT.

LOCATION.—In NW. ¼ SW. ¼ sec. 26, T. 21 N., R. 7 W., at Clark Co.'s ranch, just below mouth of Little Willow Creek and 7 miles northwest of Augusta, in Lewis and Clark County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—June 8, 1905, to May 14, 1911; April 1, 1912, to September 30, 1917.

GAGE.—Chain gage on right bank, 300 feet back of Thomas Clark's house; read by Thomas Clark.

DISCHARGE MEASUREMENTS.—Made by wading or from bridge 1,000 feet below gage.

CHANNEL AND CONTROL.—An old dam of timber and rock 20 feet below gage forms the principal control; shifts slightly at long intervals.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.88 feet June 5 (discharge, 390 second-feet); water over gage May 25 to June 4 (discharge not determined); minimum (discharge, 13 second-feet) February 23 to March 5 and March 18-25.

1905-1917: Maximum stage recorded, 10.8 feet June 23, 1916 (discharge, 1,150 second-feet); minimum stage, dry July 17, 1910.

ICE.—Probably no ice forms at this station, as a large spring enters the creek just above gage, but winter flow should be used with caution.

DIVERSIONS.—Adjudicated water rights above station amount to 36.2 second-feet from Willow Creek and 42.26 second-feet from tributaries. The United States Reclamation Service has an old right of 2.1 second-feet and has also filed on the total flow of the creek, subject to prior appropriations. No water diverted from Willow Creek proper below station, the amount used by the United States Reclamation Service being diverted from Sun River below mouth of Willow Creek.

REGULATIONS.—None. Willow Creek dam, 2 miles below station, forms a reservoir with a capacity of 84,320 acre-feet, for use on Fort Shaw unit of Sun River project. In addition to flow of Willow Creek, water will be diverted from North Fork of Sun River for storage in this reservoir.

ACCURACY.—Stage-discharge relation not permanent; affected by occasional shifts of control, usually at high stage. Rating curve used October 1 to November 15 and March 28 to May 24 well defined between 25 and 700 second-feet; curve used June 5 to September 30 fairly well defined between 20 and 250 second-feet. Gage read to half-tenths once daily; occasionally twice daily. Daily discharge ascertained by applying daily gage height to rating table. Records fair.

Discharge measurements of Willow Creek near Augusta, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
May 12	4.55	275	July 25	1.58	44.4
June 19	4.13	200	Sept. 18	.98	17.5

Monthly discharge of South Fork of Sun River at Augusta, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	142	66	99.0	6,090
November	114	63	99.0	5,890
December 1-14	111	63	83.2	2,310
March 25-31	1,120	44	362	5,030
April	286	54	130	7,740
May	2,210	170	965	59,300
June	1,500	389	718	42,700
July	370	76	179	11,000
August	76	30	49.8	3,060
September	118	38	48.7	2,900

MARIAS RIVER BASIN.

TWO MEDICINE RIVER AT FAMILY, MONT.

LOCATION.—In NE. ¼ sec. 2, T. 31 N., R. 9 W., at Holy Family Mission, in Teton County, 16 miles southeast of Browning and 6 miles above mouth of Badger Creek, the nearest tributary.

DRAINAGE AREA.—368 square miles.

RECORDS AVAILABLE.—April, 1907, to September 30, 1917.

GAGE.—Overhanging chain gage installed July 15, 1916, on left bank about 150 feet below barn belonging to Holy Family Mission; read twice daily by John Gobert. Temporary staff gage used May 4 to July 7, 1917, on account of high water. Datum of original gage, which was at same site as present gage, was lowered 0.95 foot July 21, 1908. Original chain gage and bench marks were destroyed by flood of June 2, 1913, and on June 10 a staff gage was installed at a different datum on left bank about 125 feet above site of chain gage. On July 23, 1913, this staff gage was removed to site of chain gage and was set to read 1.85 feet higher than staff gage installed June 10. Overhanging chain gage, installed September 18, 1913, was set to read 1 foot higher than staff gage installed July 23, 1913, and read to May 7, 1916, when destroyed by flood. Temporary gages at independent datum read May 16 to July 15, 1916, when present gage was installed.

DISCHARGE MEASUREMENTS.—Made by wading near gage or from old wagon bridge 3 miles above mission.

CHANNEL AND CONTROL.—Composed of gravel; shifting. Banks high and not subject to overflow except at extreme floods.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.65 feet June 8 (discharge 5,020 second-feet); minimum stage recorded, 2.50 feet August 23-25, September 14-16, 18, 20 (discharge, 24 second-feet).

1907-1917: Maximum stage recorded, 8.15 feet June 9, 1909 (discharge, 7,600 second-feet); undoubtedly higher in June, 1908, but no record available, as gage was washed out; minimum stage recorded, 1.3 feet January 12 to March 8, 1908 (discharge, 17 second-feet).

ICE.—Stage-discharge relation seriously affected by ice. Gage-height record continuous; flow estimated January 1, 11, 12, 19, 21-23, 28-31, February 1, 2, 18-28, March 1-5.

DIVERSIONS.—Water diverted about 2 miles above gage by ditch which supplies 100 acres on farm at the Holy Family Mission. From May 14 to October 24, a total diversion of 13,500 acre-feet was made by the United States Reclamation Service above the station to irrigate lands near Seville on the Blackfeet Indian Reservation.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed by high water occurring in May and June. Rating curve used until May 10, fairly well defined below 1,100 second-feet; curve used May 11 to September 30 well defined between 20 and 3,200 second-feet. Gage read twice daily to hundredths. Gage heights apparently in error and discharge estimated July 2-8; discharge interpolated July 18 and 19. Records good.

Discharge measurements of Two Medicine River near Family, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Mar. 6	A. H. Tuttle	2.28	73	July 23	W. A. Lamb	3.59	282
May 15	W. A. Lamb	6.35	3,240	Aug. 22	.....do	2.56	30.0
June 16	.....do	5.60	2,250	Sept. 16	.....do	2.47	23.8
July 1	.....do	4.63	1,250				

NOTE.—Measurements of May 15, June 16, and July 1 made from highway bridge 3 miles above gage; others by wading near gage.

Daily discharge, in second-feet, of Two Medicine River at Family, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	160	184	92	77	70	75	77	256	2,320	1,220	110	42
2	160	149	149	77	67	75	109	274	2,860	1,150	90	30
3	149	197	124	64	67	76	77	330	2,480	970	90	35
4	149	256	109	70	77	76	118	526	2,110	1,000	99	30
5	149	225	109	70	80	77	128	446	2,170	940	90	35
6	149	172	118	70	80	77	194	678	2,170	950	80	35
7	149	149	149	64	77	77	225	1,010	2,410	930	90	30
8	160	197	84	77	84	84	256	1,220	5,020	916	99	35
9	128	197	84	77	84	77	274	1,530	3,640	818	80	35
10	128	197	100	77	92	70	352	1,760	3,380	818	80	35
11	128	172	92	75	92	77	310	2,600	3,180	867	80	35
12	128	149	109	72	92	77	420	1,760	2,260	769	72	30
13	128	149	92	70	92	64	873	3,120	2,290	720	63	30
14	128	100	84	70	92	70	420	3,240	2,170	576	48	24
15	138	84	84	70	92	64	330	3,570	2,110	576	42	24
16	138	64	80	70	92	70	256	4,740	3,120	491	35	24
17	138	128	128	70	77	70	225	2,600	3,050	454	35	30
18	128	109	109	77	....	70	225	2,350	3,050	441	35	24
19	149	149	109	77	....	70	197	2,230	2,790	428	30	30
20	149	172	109	77	....	70	225	2,110	2,530	416	35	24
21	149	160	172	77	....	70	330	2,350	2,230	323	35	30
22	149	160	80	77	....	70	526	2,110	1,870	295	30	30
23	149	149	62	77	....	70	498	2,110	1,990	271	24	30
24	149	113	77	77	....	70	526	2,110	1,760	226	24	30
25	138	109	128	77	....	58	526	2,790	1,760	172	24	56
26	138	138	109	70	....	58	471	2,600	1,700	144	30	48
27	138	109	109	77	....	64	373	3,120	1,540	144	30	48
28	291	109	92	75	....	77	274	3,180	1,430	144	35	42
29	471	77	58	70	....	77	274	3,240	1,220	144	30	42
30	471	109	77	70	....	70	274	2,720	1,380	132	35	35
31	197	....	77	70	....	64	....	2,530	....	120	35	....

Monthly discharge of Two Medicine River at Family, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	471	128	170	10,400
November	256	64	148	8,810
December	172	58	102	6,270
January	77	64	73.2	4,500
February	92	67	79.7	4,430
March	84	58	71.4	4,390
April	526	77	295	17,600
May	4,740	256	2,100	129,100
June	5,020	1,220	2,400	143,000
July	1,220	120	567	34,900
August	110	24	55.3	3,400
September	56	24	33.6	2,000
The year	5,020	24	509	369,000

MARIAS RIVER NEAR SHELBY, MONT.

Location.—In sec. 20, T. 31 N., R. 2 W., at highway bridge near James A. Johnson's ranch, 7 miles south of Shelby, in Toole County.

Drainage area.—2,610 square miles.

Records available.—April 4, 1902, to January 12, 1908; April 23, 1911, to September 30, 1917.

Gage.—Chain gage on downstream side of bridge. April 4, 1902, to January 12, 1908, chain gage on highway bridge, 100 feet below present bridge; during 1911 and 1912 Bristol water-stage recorder; all gages at practically the same datum. Gage read by G. J. Moser to November 18, 1916, and by Emma Moser April 4, to September 30.

Discharge measurements.—Made from downstream side of highway bridge.

Channel and control.—Bed composed of gravel and boulders; control shifts. Left bank steep and high; not subject to overflow. Right bank gently sloping; subject to overflow at extreme stages.

Extremes of discharge.—Maximum stage recorded during year 8.4 feet May 31 (discharge, 10,000 second-feet); minimum stage recorded, 2.4 feet September 17-21 (discharge, 274 second-feet).

1902–1907 and 1911–1917: Maximum stage recorded, 14.9 feet June 24, 1907 (discharge, 29,500 second-feet); minimum stage recorded, 1.7 feet November 16–20, 1904 (discharge, 150 second-feet).

Ice.—Stage-discharge relation affected by ice November 15–18 and April 4–6; observations discontinued November 19 to April 3.

Diversions.—The Valier-Montana Land & Water Co.'s Carey project and the Blackfeet project of United States Reclamation Service divert water above this station; also a number of smaller private diversions.

Regulation.—None.

Accuracy.—Stage-discharge relation not permanent; affected by shift of control and by ice. Rating curve used October 1 to November 14 fairly well defined; shifting-control method used April 7 to May 31; curve used June 1 to September 30 well defined between 350 and 10,000 second-feet. Gage read to tenths (occasionally to half-tenths) once daily. Daily discharge ascertained by applying daily gage height to rating table. Records October 1 to November 14, fair; April 7 to May 31, poor; June 1 to September 30, good.

Discharge measurements of Marias River near Shelby, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Apr. 17	W. A. Lamb	3.45	852
June 12	.....do	7.85	8,680
Sept. 14	C. S. Heidel	2.54	370

Daily discharge, in second-feet, of Marias River near Shelby, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	550	780	....	1,060	7,340	3,330	668	600
2	595	700	....	1,260	7,580	3,500	668	600
3	640	620	....	1,480	6,620	3,160	668	510
4	686	700	....	1,480	5,230	3,160	600	420
5	732	620	....	1,650	7,580	2,700	600	476
6	778	700	....	1,820	7,340	2,700	536	368
7	824	620	1,370	2,260	4,030	2,700	536	420
8	870	550	3,830	2,700	5,910	3,330	476	420
9	780	480	3,340	3,130	5,680	3,160	600	368
10	780	550	2,870	4,530	5,730	3,160	536	368
11	700	480	2,420	4,670	6,780	3,000	600	368
12	700	410	1,950	4,390	8,830	3,160	536	320
13	700	350	1,480	5,370	7,340	1,780	476	320
14	700	410	1,590	7,080	5,680	2,020	420	320
15	620	....	1,340	6,210	5,230	1,160	368	368
16	700	....	1,090	6,210	5,800	1,240	368	320
17	620	....	850	6,350	6,140	1,160	320	274
18	620	....	875	5,650	7,340	980	536	274
19	620	....	900	4,950	7,340	1,020	420	274
20	620	....	825	6,350	6,380	980	476	274
21	410	....	900	6,070	6,380	1,060	420	274
22	620	....	900	5,790	5,680	1,160	368	320
23	620	....	900	5,510	5,230	896	420	320
24	700	....	1,700	5,370	4,610	740	368	368
25	700	....	1,700	5,930	4,610	816	320	476
26	620	....	1,620	6,930	6,860	740	420	476
27	620	....	1,550	7,080	3,160	816	368	420
28	620	....	1,480	7,230	4,220	740	368	368
29	620	....	1,340	6,930	3,850	668	420	320
30	620	....	1,200	8,460	3,330	668	476	320
31	700	....	....	10,000	....	740	600	....

NOTE.—Stage-discharge relation affected by ice Nov. 15–18 and Apr. 4–6. Gage not read Nov. 19 to Apr. 3; also Oct. 1–7, Apr. 5, 9–12, 15, 16, 18, 26, 27, 29, 30, May 5, 7, 8, 21, June 10, 11, Sept. 3 and 19.

Monthly discharge of Marias River near Shelby, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	870	410	667	41,000
November 1-14	780	350	569	23,700
April 7-30	3,830	825	1,580	75,200
May	10,000	1,060	4,960	305,000
June	8,830	3,160	5,930	353,000
July	3,500	668	1,820	112,000
August	668	320	482	29,600
September	600	274	377	22,400

BADGER CREEK NEAR FAMILY, MONT.

LOCATION.—In NE. ¼ sec. 19, T. 31 N., R. 8 W., near road crossing 4 miles east of Family, in Teton County.

DRAINAGE AREA.—241 square miles (revised); measured on topographic maps.

RECORDS AVAILABLE.—April 20, 1907, to September 30, 1917.

GAGE.—Chain gage read October 1–31, 1916, by O. J. Racine, and June 1, to September 30, by Joe Trombley. April 1, to May 31, by Aaron Racine. The original staff gage established April 20, 1907, and bench marks were washed out in the flood of June, 1908. New chain gage was established July 22, 1908, 400 feet farther upstream at a different datum. This gage was washed out May 25, 1909, and a new gage reset at different datum on the right bank, 400 feet below the old Piegan Mission crossing.

DISCHARGE MEASUREMENTS.—Made from a cable 4 miles above the gage or by wading at ford.

CHANNEL AND CONTROL.—Shifting; two channels at medium and low stages; several channels at high stage. Banks low and subject to overflow above gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 6.30 feet at 9 a. m., June 12 (discharge, 1,910 second-feet); minimum stage recorded, 4.15 feet at 6 p. m., April 18 (discharge, 122 second-feet).

1907–1917: Maximum stage recorded is that of June 12, 1917; minimum stage recorded, 3.45 feet September 25, 28, 30, 1914 (discharge, 92 second-feet); records for open-water season only; mean discharge for February, 1911, estimated at 25 second-feet.

ICE.—Observations discontinued during winter.

DIVERSIONS.—United States Reclamation Services proposes to divert the natural flow of Badger Creek to irrigate land in the eastern part of Blackfeet Indian Reservation north of Birch Creek. A small amount of water was diverted in 1917 above gage.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed June 10–19. Gage heights October 1-31 are the mean of two readings daily to half-tenths; June 1 to September 30 are the mean of two readings daily to nearest tenth. Records considered fair. Daily discharge October 1–31, April 14–20, and May 30 to June 9 are determined from a rating curve well defined between 160 and 1,600 second-feet; June 10–19 determined by indirect method for shifting control; June 20 to September 30 determined from a rating curve well defined between 140 and 800 second-feet. Records good after June 20; previous to that, fair.

Discharge measurements of Badger Creek near Family, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
May 15	6.02	1,570	July 23	4.70	309	Sept. 16	4.31	165
July 1	5.42	733	Aug. 22	4.33	167			

NOTE.—Measurement May 15 made partly by wading and partly by floats; soundings from measurement of July 23. Measurement July 1 made 1 mile above gage. Other measurements made by wading at gage.

Daily discharge, in second-feet, of Badger Creek near Family, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	275				1,300	725	223	161
2	275				1,480	725	223	136
3	265				1,240	655	190	190
4	216				1,120	725	223	190
5	189				1,120	655	223	190
6	189				1,180	690	190	161
7	202				1,480	655	223	161
8	189				1,740	620	223	161
9	189	216			1,910	585	190	161
10	202				1,680	585	190	161
11	189				1,480	554	190	161
12	189				1,220	522	190	161
13	189				1,030	522	161	161
14	189		140		950	460	161	161
15	202		160	1,570	1,220	431	161	161
16	189		140		1,490	402	161	164
17	189		140		1,660	402	161	161
18	189		122		1,580	350	161	158
19	189		180		1,320	350	161	156
20	189		225		1,180	350	161	154
21	189				1,120	303	161	154
22	189				1,020	303	167	154
23	189				970	303	136	148
24	202				925	261	136	223
25	202				925	261	136	216
26	202				880	261	136	164
27	189				880	261	136	161
28	189				800	223	136	161
29	189				840	223	136	148
30	202			1,420	762	223	161	148
31	189			1,240		223	161	

Monthly discharge of Badger Creek near Family, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	275	189	201	12,400
June	1,910	762	1,220	72,600
July	725	223	445	27,400
August	223	136	175	10,600
September	223	136	165	9,820

BIRCH CREEK AT SWIFT DAM, NEAR DUPUYER, MONT.

Location.—At Swift dam, on south boundary of Blackfeet Indian Reservation, Teton County, 20 miles west of Dupuyer and 34 miles west of Valier. North and South forks of Birch Creek unite in reservoir above station.

Drainage area.—120 square miles.

Records available.—March 26, 1913, to September 30, 1917.

Gage.—Vertical iron gage on right bank 800 feet below dam, read by Herbert C. Stalzer. Prior to July 11, 1915, a vertical wooden staff on right bank a quarter of a mile below dam was read, except June 5 to July 16, 1913, when a temporary gage on left bank immediately below dam was used to obtain high-water records. Gage for spillway overflow is inclined staff attached to left wall of the concrete canal which carries the overflow away from spillway.

Discharge measurements.—Discharge through valves measured from footbridge 300 feet above gage or by wading near gage. The spillway overflow is measured from a footbridge or by wading on crest of spillway.

Channel and control.—Stream bed clean, coarse gravel and boulders. Banks at gage high; not subject to overflow, but at old gage site 500 feet below may be overflowed at extreme stages. Canal from spillway has concrete lining not subject to shifts.

Extremes of discharge—Maximum combined flow through gates and over spillway occurred on June 17 (total discharge, 1,180 second-feet); minimum flow estimated at 1 second-foot February 14–29, March 28 to April 21.

1913–1917: Maximum discharge, 5,275 second-feet at 5 a. m. June 21, 1916; minimum discharge, 0.9 second-foot March 6, 1915. Minimum flow is controlled and maximum partly regulated by valves at dam.

Ice.—Stage-discharge relation seriously affected by ice January 18–23 and February 1 to March 27. Discharge interpolated January 18–23; February 1–5 by interpolation from measurements January 31 and February 6; February 7–13, estimated. Gates closed February 14–28. Flow estimated 1 second-foot daily. March 1–27 flow estimated by observer from gate openings on following dates and discharge computed accordingly: March 1, 20 second-feet; March 4, 20 second-feet; March 14, 60 second-feet; March 22, 40 second-feet.

Diversions.—Two small ditches divert water just below dam and above gage.

Regulation.—Dam is used to store flood and winter flow, and during dry periods will release no more water than can be handled by the canal system of the Valier Carey project in addition to amount required by prior rights. Acre-feet in storage at end of each month was as follows: October, 2,760; November, 0; December, 0; January, 0; February, 1,940; March, 3,065; April, 6,092; May, 18,610; June, 29,750; July, 21,790; August, 8,080; September, 0.

Determination of discharge.—Flow through gates in dam passes down main channel past gage; flow over spillway passes down an artificial channel and joins creek about a quarter of a mile below dam and below gage. Gage heights indicate flow through gates not diverted between dam and gage. Flow over spillway computed from gage heights by observer by applying same to rating table for short periods of each day and mean discharge for 24 hours computed. Total mean daily flow from reservoir is obtained by adding mean daily discharge from spillway to mean daily flow past gage. Spillway overflowed June 16 to July 3.

Accuracy.—Stage-discharge relation permanent for both gages. Rating curve used October 1 to June 1 for gage in channel conveying flow from valves well defined; shifting control method used June 2 to September 30. Rating curve for gage in spillway fairly well defined below 3,000 second-feet, and roughly approximate above 3,000 second-feet. Gage in channel from valves read twice daily to hundredths. Gage in spillway channel read several times daily June 16–23 and 30 and once daily June 24–29 and July 1–3; no flow over spillway during rest of year. Comparison of records for this station with those for Birch Creek near Dupuyer indicates that one or the other is in error June 1 to August 31.

Cooperation.—All field data furnished by the engineering department of the Valier-Montana Land & Water Co.; computations made by United States Geological Survey.

Discharge measurements of Birch Creek through valves at Swift dam, near Dupuyer, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 9	Ebner and Atwood.....	2.17	69	June 18	Ebner and Wardwell...	3.65	678
Feb. 6	.....do................	3.45	64	Aug. 22	Ebner and Atwood.....	3.18	370
Apr. 3	G. Ebner...............	1.15	1.3	Sept. 2	Wardwell and Gleason.	3.12	296
June 1	Ebner and Smith......	3.46	555	27	G. Ebner...............	2.80	174

Note.—Measurements made by employees of the Valier-Montana Land & Water Co.

Discharge measurements of Birch Creek, showing flow over spillway of Swift dam, near Dupuyer, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
June 18	Ebner and Wardwell	2.40	505
30	....do	1.18	153

NOTE.—Measurements made by employees of the Valier-Montana Land & Water Co.

Daily discharge, in second-feet, of Birch Creek at Swift dam, near Dupuyer, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	263	197	87	76	70	20	1	159	565	864	360	295
2	259	197	87	79	69	20	1	175	557	832	365	295
3	259	187	87	74	68	20	1	178	549	664	365	291
4	259	187	87	71	66	20	1	187	549	581	365	286
5	259	187	84	71	65	20	1	197	549	581	365	286
6	259	187	84	68	64	20	1	197	541	573	365	286
7	259	187	84	68	60	20	1	197	533	573	365	286
8	259	184	84	68	60	20	1	207	525	573	365	286
9	259	178	84	67	60	20	1	227	518	581	365	282
10	259	167	84	68	60	20	1	241	510	581	360	282
11	259	167	84	74	20	20	1	256	510	581	365	282
12	259	167	84	74	20	20	1	295	503	503	360	282
13	259	164	82	70	20	40	1	332	533	406	365	282
14	259	159	81	70	1	60	1	400	605	376	370	282
15	252	156	81	71	1	60	1	496	630	376	365	278
16	238	153	79	76	1	60	1	510	826	370	365	278
17	230	153	79	77	1	60	1	503	1,180	370	370	278
18	227	148	79	76	1	60	1	503	1,080	370	370	271
19	220	148	79	72	1	60	1	503	1,050	354	370	271
20	220	143	77	68	1	60	1	503	1,030	354	370	263
21	220	140	76	66	1	60	1	503	965	360	370	244
22	220	133	76	62	1	40	41	510	872	360	370	238
23	216	128	76	58	1	40	46	510	775	354	365	238
24	216	117	76	57	1	40	52	510	740	360	360	210
25	213	133	79	52	1	40	55	533	739	354	348	197
26	213	148	77	64	1	40	74	541	605	354	338	178
27	213	133	76	57	1	25	91	541	734	360	327	173
28	213	117	77	57	1	1	91	549	680	360	309	150
29	210	106	79	64	....	1	91	557	637	360	304	110
30	207	102	79	68	....	1	104	565	724	365	300	96
31	207	....	79	71	....	1	....	573	....	365	295	....

NOTE.—The above table shows flow through valves and over spillway. Gates closed Feb. 14–28 and Mar. 28 to Apr. 21; flow estimated at 1 second-foot, and represents leakage through gates. Mar. 1–27 flow estimated by observer, based upon gate openings, as stage-discharge relation was affected by backwater from ice in channel. See "Ice" for periods Jan. 18–23 and Feb. 1–13.

Monthly discharge of Birch Creek at Swift dam, near Dupuyer, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	263	207	238	14,600
November	197	102	156	9,280
December	87	76	80.9	4,970
January	79	52	68.2	4,190
February	....	....	25.6	1,420
March	....	....	31.9	1,960
April	104	....	22.2	1,320
May	573	159	392	24,100
June	1,180	503	694	41,300
July	864	354	465	28,600
August	370	295	355	21,800
September	295	96	249	14,800
The year	1,180	....	233	168,000

NOTE.—The above table shows total flow through valves and over spillway. Minimum flow of February, March, and April estimated at 1 second-foot, and represent leakage through gates which were closed during parts of these months.

BIRCH CREEK NEAR DUPUYER, MONT.

LOCATION.—In sec. 28, T. 29 N., R. 8 W., at Kepple's ranch, half a mile above head gates of B canal of Valier-Montana Land & Water Co., 12 miles northwest of Dupuyer, Teton County, and 20 miles above mouth of Dupuyer Creek.

DRAINAGE AREA.—155 square miles (measured on Land Office map).

RECORDS AVAILABLE.—July 25, 1907, to September 30, 1917.

GAGE.—Vertical 1-inch square steel bar marked to tenths located same as previous one; was replaced July 5, 1916, and referred to approximately the same datum as the previous gages at this location. May 12 a high-water staff gage was set at this same section but was not used. Low-water section was washed out June 18 and a new one installed on June 19, which was loose and unsatisfactory until June 30, when it was set to correct datum and securely fastened. June 23–30 the old sloping gage was read. Gage read by John Ryan.

A chain gage on right bank about 250 feet below inclined staff was used July 25, 1907, until June, 1908, when it was washed out. A temporary staff 200 feet below old chain gage was used July 23 to October 1, 1908, when a new chain gage was installed on right bank a quarter of a mile above old site. Chain gage used until December 31, 1913. Inclined staff read with datum unchanged January 1, 1914, to December 31, 1915. There is no relation determined between gage datums for the different sections. January 1, 1916, a vertical 1-inch square steel bar marked to tenths and located about 1,000 feet downstream was used. This was washed out June 21, 1916; observer set temporary gage at same location June 23 and it was read until July 5, 1916.

DISCHARGE MEASUREMENTS.—Made by wading or from cable. Cable originally 100 feet below inclined gage, but was moved downstream to 75 feet below new vertical steel staff; washed out June 21, 1916, and replaced May 7, 1917, at original site.

CHANNEL AND CONTROL.—Rock and gravel at inclined gage; principal control is riffle about 100 feet below; shifting. Large clean gravel at new gage section; control is gravel bar about 250 feet below gage. Banks at both sections are of medium height covered with brush and subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.62 feet June 17 (discharge, 1.080 second-feet); minimum stage recorded, 3.66 feet April 19 (discharge, 28 second-feet). A lower stage may have been reached during the winter period.

1907–1917: Maximum stage recorded, 10.0 feet June 21, 1916 (discharge estimated, 5,000 second-feet); minimum stage recorded April 21–30, 1915 (discharge 7 second-feet.)

ICE.—Stage-discharge relation seriously affected by ice; data inadequate to warrant estimates of flow December 12 to April 6.

DIVERSIONS.—Two or three small ditches divert above station.

REGULATION.—The flow is largely controlled by Swift dam at the Birch Creek reservoir with a storage capacity of 30,000 acre-feet, 12 miles upstream from station.

ACCURACY.—Stage-discharge relation affected by shifting control. Rating curve used October 1 to June 20 well defined between 20 and 1,000 second-feet; curve used June 21-30 based on gage heights of inclined gage, fairly well defined between 600 and 850 second-feet; July 1, to September 30 well defined between 80 and 750 second-feet. Gage read to hundredths once daily. Daily discharge obtained by applying daily gage height to rating table. Records fair.

COOPERATION.—Gage heights and most of discharge measurements furnished by engineering department of Valier-Montana Land & Water Co.

Discharge measurements of Birch Creek near Dupuyer, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 16	Ebner and Dean [a]	4.89	245	May 3	Ebner and Stalzer [a]	4.71	182
Dec. 22	Ebner and Palin [a]	6.04	78.2	5	G. Ebner	4.70	185
Jan. 6	.....do	5.35	84.1	12	Ebner and Gleason [a]	5.32	359
23	Ebner and Piper [a]	5.60	68.6	June 19	Ebner and Wardwell [a]	6.40	926
Feb. 9	G. Ebner	5.90	79	23	T. M. Wardwell	5.82	725
28	Atwood [a] and Ebner	3.75	25.0	30	Ebner and Wardwell	5.86	743
Mar. 17	Ebner and English [a]	3.70	20.1	July 21	T. M. Wardwell	5.08	384
Apr. 7	.....do	4.72	49.6	Aug. 17	.....do	4.95	328
19	Ebner and Heidel	3.66	29.1	Sept. 17	Ebner and Carmody [a]	4.69	270

[a] Employee of Valier-Montana Land & Water Co.

Daily discharge, in second-feet, of Birch Creek near Dupuyer, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	245	206	110		138	562	715	352	304
2	245	206	110		161	430	663	352	304
3	245	206	118		184	391	663	352	304
4	245	206	118		184	391	663	352	304
5	245	206	127		184	373	663	352	288
6	245	195	127		200	373	663	352	288
7	245	195	110	145	216	373	663	352	288
8	245	190	85	82	231	373	663	352	288
9	245	184	110	55	245	373	663	352	288
10	231	184	102	55	289	373	663	352	288
11	231	184	102	50	321	430	562	352	274
12	231	174		44	355	430	562	352	274
13	231	164		44	391	493	427	352	274
14	231	145		42	450	493	388	336	274
15	231	145		39	515	493	388	336	259
16	231	184		39	515	515	388	336	259
17	231	174		34	515	1,080	388	336	259
18	231	174		30	515	860	388	336	246
19	231	164		28	515	930	388	336	246
20	218	174		29	562	860	388	319	232
21	218	164		30	562	798	388	319	232
22	218	154		30	515	750	388	319	232
23	218	154		35	515	708	388	319	232
24	206	145		35	515	665	388	319	220
25	206	145		40	515	590	388	319	207
26	206	136		45	538	590	388	319	207
27	206	136		69	515	590	370	319	184
28	206	118		85	613	590	352	319	184
29	206	110		100	562	590	352	319	163
30	206	110		115	538	665	352	319	144
31	206				613		352	319	

NOTE.—Discharge interpolated on account of no gage-height record Oct. 13, Nov. 8, Apr. 14, 28, 29, May 1, 2, 4, 6, and 7.

Monthly discharge of Birch Creek near Dupuyer, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	245	206	227	14,000
November	206	110	168	10,000
December 1-11	127	85	111	2,420
April 7-30	145	28	54.2	2,580
May	613	138	409	25,100
June	1,080	373	571	34,000
July	715	352	486	29,900
August	352	319	336	20,700
September	304	144	252	15,000

BIRCH CREEK AT NELSON'S RANCH, NEAR DUPUYER, MONT.

LOCATION.—In NW. ¼ sec. 27, T. 29 N., R. 8 W., a quarter of a mile below headworks of B canal of Valier-Carey project, at Nelson's ranch, 11 miles northwest of Dupuyer, in Teton County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 8, 1914, to September 30, 1917.

GAGE.—Vertical iron staff on right bank a short distance above the ranch building; read since July 1, 1916. The inclined wooden staff at same location and datum used prior to June 18, 1916, was destroyed by flood June 19–21, 1916; gage read by John Ryan.

DISCHARGE MEASUREMENTS.—Made by wading 100 feet above gage.

CHANNEL AND CONTROL.—Composed of cobblestones and gravel; shifts at extreme floods. Occasionally obstructed by growth of aquatic plants in summer.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.30 feet June 18 (discharge, 1,040 second-feet); minimum stage recorded was 2.70 feet September 22, 25, and 26 (discharge, 14 second-feet).

1914–1917: Maximum stage recorded, 5.30 feet June 18, 1917 (discharge, 1,040 second-feet); a higher stage occurred June 19–21, 1916, when gage was washed away (stage and discharge unknown). No flow October 18–24, 1914, March 28 to April 5 and April 8–30, 1915.

ICE.—Stage-discharge relation seriously affected by ice December 8 to March 19; data are inadequate to compute flow for period; gage-height record practically complete for period.

DIVERSIONS.—The B canal and several small ditches divert water above station.

REGULATION.—Except during floods, the discharge is controlled by Swift dam and by the headworks of B canal.

ACCURACY.—Stage-discharge relation permanent during open-channel periods. Rating curve based on 6 measurements and is very well defined between 25 and 350 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good.

COOPERATION.—Gage heights and some of discharge measurements furnished by engineering department of Valier-Montana Land & Water Co.

Discharge measurements of Birch Creek at Nelson's ranch, near Dupuyer, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 16	G. Ebner [a]	3.79	241	July 14	Wardwell and Ebner	3.42	121.2
Apr. 19	Ebner and Heidel	2.89	30.7	July 21	T. M. Wardwell	3.15	62.2
Aug. 17	T. M. Wardwell [a]	3.12	59				

[a] Employee of Valier-Montana Land & Water Co.

Daily discharge, in second-feet, of Birch Creek at Nelson's ranch, near Dupuyer, Mont., for the year ending Sept., 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	255	219	141	....	27	....	710	600	59	52
2	255	219	100	....	....	....	562	567	59	52
3	255	219	102	....	....	179	512	545	59	52
4	259	215	119	....	....	....	485	545	62	52
5	259	211	138	....	438	....	480	545	61	52
6	259	211	138	....	141	....	480	518	59	52
7	263	211	156	....	72	....	474	490	59	52
8	263	209	....	....	56	....	474	490	59	52
9	259	207	....	....	51	....	474	490	59	52
10	250	207	....	....	43	....	490	490	59	52
11	246	204	....	....	39	....	572	438	59	51
12	246	190	....	....	34	....	534	396	59	51
13	246	166	....	....	33	....	655	242	59	51
14	246	141	....	....	32	....	655	141	58	51
15	246	141	....	....	32	545	655	72	58	51
16	246	190	....	....	27	545	677	69	58	51
17	246	156	....	....	22	545	858	66	58	51
18	246	150	....	....	32	545	1,040	64	56	51
19	238	163	....	....	31	545	875	64	56	53
20	238	172	....	792	31	600	858	64	56	53
21	230	163	....	518	32	611	836	64	56	53
22	230	156	....	386	32	594	732	64	56	14
23	226	147	....	572	34	589	710	64	56	56
24	226	144	....	682	34	589	710	62	56	56
25	226	133	....	694	39	589	644	62	56	14
26	226	125	....	738	43	644	644	62	56	14
27	226	119	....	638	76	594	545	61	55	59
28	226	117	....	572	....	732	545	59	53	59
29	226	114	....	584	....	710	545	59	53	56
30	223	128	....	545	....	682	545	59	53	56
31	219	....	....	412	....	765	....	59	53	....

NOTE.—No gage heights on following days: Oct. 13, Nov. 8, Apr. 14 and June 17 (discharge interpolated); Apr. 2-4, Apr. 28 to May 2, May 4-14 (discharge not determined owing to diversions).

Monthly discharge of Birch Creek at Nelson's ranch, near Dupuyer, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	263	219	242	14,900
November	219	114	172	10,200
December 1-7	156	100	128	1,780
March 20-31	792	386	594	14,200
June	1,040	474	632	37,600
July	600	59	244	15,000
August	62	53	57.3	3,520
September	59	14	49.0	2,920

BIRCH CREEK AT ROBARE, MONT.

LOCATION.—In N. ½ sec. 31, T. 30 N., R. 7 W., near former post office of Robare, 14 miles west of Valier and 10 miles north of Dupuyer, in Teton County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—June 4, 1914, to September 30, 1917.

GAGE.—An inclined staff on right bank, half a mile downstream from old post office at Robare. This was washed out in spring of 1917. April 14, 1917, a vertical steel staff graduated to tenths was installed at the same location and the same datum.

DISCHARGE MEASUREMENTS.—Made by wading near the gage.

CHANNEL AND CONTROL.—Bed of stream is composed of cobblestones and is fairly permanent. Stream flows in two channels at high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.45 feet June 18 (discharge, 870 second-feet); minimum stage recorded, 1.25 feet September 26 (discharge, 24 second-feet).

1914–1917: Maximum stage recorded, 4.11 feet June 17, 1916 (discharge, 1,010 second-feet); minimum stage, 1.64 feet May 11, 1915 (discharge, 0.4 second-foot).

ICE.—Stage-discharge relation seriously affected by ice. Observations discontinued November 10 to April 13.

DIVERSIONS.—Most of water at ordinary stages is diverted or stored above station.

REGULATION.—Discharge largely controlled by operation of Swift dam, the B canal headworks, and several smaller ditches.

ACCURACY.—Stage-discharge relation affected by shifting control. The rating curves are well defined except at high stages. Shifting-control method used July 11–19. Gage read to hundredths once daily. Daily discharge obtained by applying daily gage height to rating table. Records good.

COOPERATION.—Discharge measurements and gage heights furnished by engineering department of Valier-Montana Land & Water Co.

Discharge measurements of Birch Creek at Robare, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 14	Ebner and Angell	1.33	44.1	July 20	G. Ebner	1.52	55.9
May 9	Ebner and Hipp	2.05	237	28	Wardwell and Ebner	1.42	36.6
July 10	G. Ebner	2.58	459	Sept. 6	G. Ebner	1.44	39.3

NOTE.—Measurements made by employees of engineering department of Valier-Montana Land & Water Co.

Daily discharge, in second-feet, of Birch Creek at Robare, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	268	233		164	578	534	38	47
2	276	236		192	574	520	37	46
3	272	233		192	448	506	38	46
4	281	233		192	430	506	50	46
5	276	233		181	439	484	40	46
6	276	229		206	452	493	45	42
7	268	225		225	430	466	45	44
8	268	229		225	434	462	45	41
9	264	229		236	444	466	46	44
10	264			272	462	466	46	44
11	256			281	547	457	46	44
12	256			293	547	376	42	41
13	256			358	560	297	45	41
14	256		45	380	565	155	44	41
15	256		45	448	556	125	44	40
16	260		47	457	565	116	45	41
17	264		41	452	805	62	44	41
18	260		40	452	870	59	45	42
19	252		41	470	770	52	45	44
20	252		41	493	795	53	46	44
21	252		45	506	745	53	47	41
22	248		45	493	655	53	47	37
23	248		47	480	646	44	46	40
24	248		47	480	650	42	46	53
25	244		48	516	610	40	46	50
26	244		55	520	610	40	44	34
27	248		79	516	560	40	45	52
28	236		104	583	516	38	46	53
29	236		112	624	520	38	46	49
30	236		109	588	520	38	46	45
31	233			578		38	46	

NOTE.—Gage not read Sept. 29 and 30; discharge interpolated.

Monthly discharge of Birch Creek at Robare, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	281	233	257	15,800
November 1-9	236	225	231	4,120
April 14-30	112	40	58.3	1,970
May	624	164	389	23,900
June	870	430	577	34,300
July	534	38	230	14,100
August	50	37	44.5	2,740
September	53	24	43.9	2,610

DUPUYER CREEK NEAR VALIER, MONT.

LOCATION.—In NE. ¼ NW. ¼ sec. 33, T. 29 N., R. 6 W., at Cowell ranch, 1,000 feet above diversion dam at head of D canal from Dupuyer Creek to Lake Frances reservoir and outlet of B canal, which diverts water from Birch Creek to Dupuyer Creek; 6 miles below mouth of Sheep Creek and 11 miles southwest of Valier, Teton County, the nearest railway point.

DRAINAGE AREA.—111 square miles (measured by Valier-Montana Land & Water Co.).

RECORDS AVAILABLE.—July 17, 1912, to September 30, 1917.

GAGE.—Vertical steel staff on right bank, 1,000 feet above diversion dam, since June 23, 1916; read by E. D. Perkins. An overhanging chain gage was used to May 15, 1913; a vertical wooden staff May 16, 1913, to April 1, 1914; an inclined wooden staff April 2, 1914, to March 12, 1915; and a vertical steel staff March 13, 1915, to February 17, 1916, when it was bent over by ice. The inclined wooden staff was read until a new vertical steel staff was set March 24, which was read until both it and the inclined wooden staff were washed out on June 21; datum unchanged; all gages at same site. A Bristol water-stage recorder was installed but has not been used since 1912, and the well was completely washed out June 21, 1916.

DISCHARGE MEASUREMENTS.—Made by wading at low stages. High-water measurements made by floats, or from bridge 5 miles below gage. Cable 30 feet below gage has not been repaired since support on right bank was undermined June 21, 1916.

CHANNEL AND CONTROL.—Bed of stream coarse gravel; right bank high and steep; left slopes gradually and is overflowed only at flood stage. A bar or ledge that produces a riffle about 400 feet below the gage forms the control at certain stages. Measuring section obstructed during the late summer and fall by growth of algae.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.94 feet March 29 at 9.50 a. m. (discharge, 1,500 second-feet, based on measurements made March 28 and 29); minimum open-water stage, 2.76 feet September 23 at 3 p. m. (discharge, 25 second-feet). A lower minimum occurred during winter as indicated by measurement of March 16.

1912–1917: Maximum stage recorded, 6.5 feet on June 21, 1916, determined by level from flood marks (discharge, 2,180 second-feet); minimum stage, 2.22 feet August 9, 1914 (discharge, 4.4 second-feet).

ICE.—Stage-discharge relation seriously affected by ice. Discharge November 15–30 and March 1 to April 9 estimated by comparison with Birch Creek and by special study in connection with temperatures and measurements made during winter. No discharge computed December 1 to February 28.

DIVERSIONS.—A number of small ditches divert water for irrigation from Dupuyer Creek and tributaries; many of the numerous water-right filings have been perfected by use.

Regulation. None.

Accuracy.—Stage-discharge relation changed during the last part of April. Rating curve used for the open-water periods October 1 to April 17 well defined between 50 and 1,800 second-feet; shifting-control method used April 18–30; curve used May 1 to September 30 well defined between 20 and 2,000 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table.

Discharge measurements of Dupuyer Creek near Valier, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 14	Ebner and Carmody	2.92	54	Apr. 10	G. Ebner	3.33	130
Nov. 20	Chadwick and Pieper	[a] 3.47	55	18	Ebner and Heidel	2.94	54
Dec. 29	Ebner and Savage	[a] 3.58	44.9	May 10	Ebner and Lamb	3.76	236
Jan. 20	G. Ebner	[a] 3.75	38.4	22	Ebner and Gleason	4.18	401
Feb. 7	.....do	[a] 4.62	49.6	June 1	Chadwick and Gleason	4.83	771
9	Ebner and Chadwick	[a] 4.55	52.8	13	Ebner and Wardwell	4.14	444
Mar. 16	G. Ebner	[a] 3.96	22.4	July 2	T. M. Wardwell	3.52	155
28	Ebner and Hipp	[a] 5.04	173	17	Wardwell and Thomas	3.13	71
29	.....do	[a] 6.56	[b] 1,150	Aug. 11	Wardwell and Siverson	2.96	44.9
Apr. 4	Ebner and Wilke	[a] 4.62	169	Sept. 8	T. M. Wardwell	2.82	30.8
7	Ebner and English	[a] 4.42	249				

[a] Stage-discharge relation affected by ice. [b] Velocity determined by use of floats.

Daily discharge, in second-feet, of Dupuyer Creek near Valier, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	46	61					300	95	815	156	45	35
2	48	57					250	87	716	150	51	32
3	50	58					220	85	510	148	45	34
4	52	60					200	89	594	130	45	34
5	58	61					200	106	538	125	39	34
6	65	62					220	130	409	125	51	32
7	70	60			50		250	184	434	116	49	32
8	68	57					190	203	458	114	50	32
9	65	55			53		130	212	484	105	49	35
10	64	54					128	229	1,000	103	54	37
11	62	52					108	262	885	99	51	35
12	60	58					100	280	748	95	46	32
13	58	57					87	300	409	87	45	30
14	53	55					85	300	363	83	44	34
15	52						65	280	363	83	38	32
16	52						57	300	363	80	34	34
17	56						55	320	320	68	32	28
18	61						54	243	342	69	28	28
19	65						60	262	342	68	27	30
20	74			38			55	280	342	60	30	29
21	83						104	510	280	58	28	28
22	77						140	409	262	51	30	28
23	71						119	320	300	49	30	25
24	65						110	280	243	47	30	58
25	58						113	320	216	45	30	51
26	52					70	135	363	209	51	30	39
27	62					120	113	594	194	52	32	28
28	71					173	98	623	194	51	32	28
29	69		45			1,500	94	654	178	44	28	28
30	67					800	89	684	178	45	28	28
31	65					400		594		51	35	

Note.—Discharge interpolated on account of missing gage readings: Oct. 1–3, 5, 8. 10, 12, 15, 17, 18, 20, 22, 24, 25, 27, 29, 30; Nov. 1, 3–5, 7, 8, 10; Sept. 20. Discharge June 10 estimated from comparison of records for Birch Creek.

Discharge Nov. 15 to Apr. 9 estimated because of ice, as follows: Nov. 15–30, 55 second-feet; Mar. 1–5, 33 second-feet; Mar. 6–10, 28 second-feet; Mar. 11–15, 23 second-feet; Mar. 16–20, 22 second-feet; Mar. 21–25, 70 second-feet.

Monthly discharge of Dupuyer Creek near Valier, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	83	46	61.9	3,810
November	62	52	56.2	3,340
March	1,500		127	7,810
April	300	54	131	7,800
May	684	85	310	19,100
June	1,000	178	423	25,200
July	156	44	84.1	5,170
August	54	27	38.2	2,350
September	58	25	32.9	1,960

CUT BANK CREEK AT CUT BANK, MONT.

LOCATION.—In SW. ¼ sec. 1, T. 33 N., R. 6 W., at Great Northern Railway bridge 12 miles above junction with Two Medicine River, half a mile west of Cut Bank, in Toole County.

DRAINAGE AREA.—971 square miles.

RECORDS AVAILABLE.—August 4, 1905, to September 30, 1917.

GAGE.—Vertical staff nailed to pier protecting left bank of creek 10 feet above center line of Great Northern Railway bridge; used since August 31, 1911; prior to that date, a chain gage on left bank 200 yards farther downstream. Read by Charles Ferres.

DISCHARGE MEASUREMENTS.—Made from highway bridge a quarter of a mile below gage or by wading.

CHANNEL AND CONTROL.—Rock and gravel bar 200 feet below gage forms principal control; shifts. At high stages creek is 200 to 300 feet wide, but at low stages narrows at principal control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.1 feet at 7 a. m. June 12 (discharge, 1,740 second-feet); minimum stage recorded, 3.80 feet September 19–21 (discharge, 20 second-feet).

1905–1917: Maximum stage recorded, 10.0 feet June 5, 1908, (discharge computed from extension of rating curve, 8,810 second-feet); minimum, 2.5 feet November 29, 30, 1905 (discharge, 5 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

DIVERSIONS.—Intake of Great Northern Railway's pumping station is 100 feet below gage; average quantity pumped is about 14,000 gallons an hour for 18 hours a day, equivalent to a continuous flow of 0.4 second-foot. There are also some small diversions for irrigation on the Blackfeet Indian Reservation above gage.

REGULATION.—None.

ACCURACY.—Stage-discharge relation seriously affected by ice and by radical changes in the control. Rating curve used October 1 to November 9 fairly well defined; curve used April 11 to May 12 and May 27 to August 24 well defined between 60 and 1,600 second-feet; shifting-control method used August 25 to September 30. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records only fair, as observer's readings have been found in error occasionally.

Discharge measurements of Cut Bank Creek at Cut Bank, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Nov. 28	a4.42	43.3	Aug. 20	3.96	65
June 12	5.95	1,540	Sept. 12	3.98	45
28	5.09	622			

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Cut Bank Creek at Cut Bank, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	62	62	....	239	1,350	592	136	62
2	73	62	....	216	1,290	592	129	62
3	79	62	....	262	1,110	555	120	60
4	88	62	....	338	1,000	555	120	60
5	97	62	....	311	800	555	120	57
6	110	62	....	301	710	555	136	57
7	110	62	....	301	710	520	136	55
8	103	69	....	311	850	485	136	55
9	97	79	....	364	1,170	485	136	55
10	88	....	....	422	1,350	422	136	49
11	73	....	1,350	485	1,540	422	136	44
12	69	....	1,110	485	1,610	422	120	46
13	62	....	592	....	1,540	422	120	39
14	62	....	454	....	1,350	393	120	35
15	62	....	364	....	1,110	364	120	35
16	62	....	286	....	950	364	120	32
17	73	....	262	....	1,060	311	120	26
18	88	....	253	....	1,230	301	120	23
19	79	....	262	....	1,060	286	103	20
20	73	....	272	....	900	262	75	20
21	73	....	262	....	900	262	103	20
22	69	....	286	....	900	239	103	28
23	62	....	311	....	850	216	103	28
24	62	....	364	....	800	208	97	35
25	55	....	364	....	800	195	86	35
26	51	....	364	....	755	182	83	44
27	51	....	364	950	710	174	81	49
28	62	....	311	1,000	670	166	78	35
29	62	....	301	1,110	630	155	78	35
30	62	....	262	1,350	630	155	64	35
31	62	....	....	1,480	....	136	64	....

NOTE.—Stage-discharge relation may have been slightly affected by ice Nov. 8 and 9.

Monthly discharge of Cut Bank Creek at Cut Bank, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	110	51	73.6	4,530
November 1-9	79	62	64.7	1,150
April 11-30	1,350	253	420	16,700
June	1,610	630	1,010	60,100
July	592	136	353	21,700
August	136	64	110	6,760
September	62	20	41.3	2,460

TETON RIVER AT STRABANE, MONT.

LOCATION.—In SE. ¼ NE. ¼ sec. 35, T. 25 N., R. 7 W., at highway bridge on Peebles's ranch, at Strabane, in Teton County, 16 miles above Chouteau.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—November 26, 1904, to December 31, 1906, and June 1, 1908, to September 30, 1917.

GAGE.—Chain gage on upstream side of highway bridge installed March 23, 1911; read by Jas. Peebles, jr. November 26, 1904, to March 8, 1905, a staff gage 40 feet above head of Kroff's irrigation ditch; March 9, 1905, to May 7, 1906, a staff gage 250 feet upstream; May 8, 1906, to December 31, 1906, a staff gage at Bjornstad's ranch 1½ miles above gage at site of gage used to May 7, 1906. All gages at different datums.

DISCHARGE MEASUREMENTS.—Made by wading or from bridge.

CHANNEL AND CONTROL.—Bed composed of coarse gravel, likely to shift. Several channels at medium and high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 6.45 feet at 11 a. m. May 26 (discharge, 2,460 second-feet); minimum stage, 3.15 feet March 13 (discharge, 42 second-feet).

ICE.—Stage-discharge relation seriously affected by ice except for short periods, as current is swift and river is seldom under complete ice cover.

DIVERSIONS.—The Teton Cooperative Co.'s canal diverts water 1 mile above gage for a Carey Act project.

ACCURACY.—Stage-discharge relation changed during May. Rating curve used October 1 to May 12 well defined below 2,000 second-feet; curve used May 28 to September 30 well defined between 70 and 1,000 second-feet; shifting-control method used May 13–27. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good, except those for May 13–27, which are fair.

Discharge measurements of Teton River at Strabane, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr 14	C. S. Heidel	3.34	54	July 24	W. A. Lamb	2.71	218
June 8	W. A. Lamb	4.88	918	Sept. 17	.....do	2.10	84
28	.....do	3.80	493				

Daily discharge, in second-feet, of Teton River at Strabane, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	128	96	79	82	68	54	49	62	928	493	192	126
2	128	96	78	80	66	54	49	60	873	493	192	137
3	128	96	78	79	66	55	49	58	775	465	192	126
4	128	58	79	77	62	53	49	62	775	465	181	126
5	121	66	79	77	58	52	50	63	775	465	181	126
6	121	65	79	75	54	52	50	64	775	437	181	126
7	121	64	79	73	53	50	50	64	822	437	181	122
8	118	66	78	73	50	50	50	64	928	437	170	118
9	114	66	78	71	52	47	52	85	873	383	170	116
10	111	68	79	66	52	45	52	136	775	383	170	116
11	108	71	79	70	50	44	52	164	775	383	170	111
12	106	76	80	71	52	42	53	220	692	383	159	111
13	108	85	80	71	54	42	53	475	522	383	159	105
14	108	80	80	72	58	43	54	725	552	357	159	105
15	102	79	80	72	58	43	52	850	654	331	148	84
16	102	77	81	71	56	44	50	1,140	822	306	148	94
17	104	75	81	71	56	44	52	942	988	306	148	88
18	106	77	80	70	55	45	52	942	928	282	148	88
19	108	75	80	70	54	46	52	942	822	282	148	84
20	108	75	80	70	54	47	52	895	732	259	137	84
21	108	77	79	70	55	47	52	895	618	259	137	84
22	106	79	79	70	56	47	58	942	552	248	137	88
23	108	80	79	70	56	47	60	942	552	236	137	94
24	108	81	79	71	56	47	62	990	552	225	137	101
25	106	80	79	71	58	47	63	1,570	522	214	137	105
26	106	79	80	71	58	47	63	2,290	522	214	137	113
27	104	80	80	72	58	48	64	1,710	493	214	126	124
28	106	79	80	72	56	48	63	1,510	493	203	126	122
29	107	79	82	72	....	48	62	1,260	552	203	126	105
30	108	79	82	70	....	49	62	1,190	493	192	126	94
31	108	....	82	70	....	49	....	988	....	192	126	....

NOTE.—Stage-discharge relation affected by ice jam Nov. 28; discharge interpolated.

Monthly discharge of Teton River at Strabane, Mont., for the year ending Sept. 30, 1917

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	128	102	111	6,82[illegible]
November	96	56	76.8	4,57[illegible]
December	82	78	79.6	4,8[illegible]
January	82	66	72.3	4,45[illegible]
February	68	50	56.5	3,14[illegible]
March	55	42	47.6	2,93[illegible]
April	64	49	54.4	3,240
May	2,290	58	719	44,200
June	988	493	704	41,900
July	493	192	327	20,100
August	192	126	154	9,470
September	137	84	107	6,370
The year	2,290	42	210	152,000

TETON RIVER NEAR CHOUTEAU, MONT.

LOCATION.—On south line of SW. ¼ sec. 25, T. 24 N., R. 5 W., at highway bridge 1½ miles southwest of Chouteau, Teton County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—November 30, 1904, to July 31, 1906; May 27 to December 6, 1913; and April 14, 1915, to September 30, 1917.

GAGE.—Vertical staff fastened to pile on downstream side of bridge near left bank; read by M. G. Read. Original gage, a chain attached to upstream handrail of bridge, was stolen before any observations were made; replaced May 9, 1905, by chain gage at same datum fastened to floor of bridge. Gage used in 1913 same as that used in 1915–16.

DISCHARGE MEASUREMENTS.—Made by wading from bridge at gage, or from bridge 2 miles below gage. If made from lower bridge, the flow of Deep Creek is deducted

CHANNEL AND CONTROL.—Stream bed gravelly and likely to shift. Right bank high and not subject to overflow; left bank lower and may be overflowed during extreme floods.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.1 feet June 18 (discharge 1,550 second-feet); water was over top of gage, 6.7 feet, May 21–29; minimum stage recorded, 3.45 feet September 17 (discharge, 2.8 second-feet).

1904–1906, 1913, and 1915–1917: Maximum stage recorded, 8.7 feet June 21, 1916 (determined from flood marks) (discharge not determined); minimum discharge recorded 1 second-foot August 9–16, 20, 1913. Discharge also estimated at 1 second-foot several days in April, May, and July, 1906.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

DIVERSIONS.—Numerous diversions above gage for irrigation. See miscellaneous measurements, page —.

REGULATION.—Low flow during summer caused by diversions.

ACCURACY.—Stage-discharge relation not permanent; affected by shifting control, by ice, and by drift lodged against pier of bridge. Rating curve used October 1 to December 19 fairly well defined below 1,000 second-feet; curve used April 14 to May 13, and June 18 to September 30 well defined below 1,000 second-feet. May 14–22, and May 30 to June 17 stage-discharge relation seriously affected by brush lodged against bridge pier; discharge obtained by indirect method for shifting control. May 23–29 water above gage; flow not computed on account of uncertainty in flow in canals above station. Records poor owing to unsatisfactory gage-height record during most of year.

Discharge measurements of Teton River near Chouteau, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 14	C. S. Heidel	4.62	73	July 2	W. A. Lamb	5.71	370
May 22	W. A. Lamb	[a] 5.78	539	23	.....do	4.08	24.4
June 7	.....do	[a] 6.45	736	Aug. 24	.....do	3.70	7.6
18	.....do	6.70	1,150	Sept. 17	.....do	3.45	2.9

[a] Stage-discharge relation seriously affected by brush lodged against bridge pier.

Daily discharge, in second-feet, of Teton River near Chouteau, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	56	61	56		92	1,190	320		
2	56	56	56		94	1,110	371		
3	56	56	56		94	983	280		
4	56	56	56		99	954	262		
5	56	56	56		99	926	244		
6	56	56	53		99	851	211		
7	59	56	50		113	737	135		
8	63	56	48		116	656	99		
9	67	56	44		116	729			
10	71	56	40		135	664			
11	75	56	40		135	664			
12	75	56	40		157	640			
13	70	56	40		157	644			
14	66	56	40	74	205	648			
15	66	56	40	74	211	588			
16	69	56	40	71	269	762		24	
17	72	56	40	56	361	1,450		12	2.8
18	75	56	40	59	625	1,550		12	
19	75	56	40	71	437	1,110			
20	86	56		80	737	779	71		
21	86	56		87	638	695			
22	75	56		81	538	545			
23	75	56		80		479	26		
24	70	56		71		449		7.5	
25	66	56		74		419			
26	66	56		80		392			
27	66	56		84		343			
28	66	56		84		320			
29	66	56		92		300			
30	66	56		92	1,290	280			
31	66				1,170				

NOTE.—Gage read on following days: Oct. 2, 4, 6, 11-12, 14-15, 18-23, 25-29, 31; Nov. 2, 4, 6, 8, 11-12, 16, 28; Dec. 1-3, 5, 8, 10, 12, 14, 17, 19. No gage readings Dec. 20 to Apr. 13; Apr. 14-30; May 1-20, 22, 30-31; June 1-12, 14-30; July 1-8; 20, 23; Aug. 16-18, 24; Sept. 17. Discharge interpolated for days of missing gage readings Oct. 1 to Dec. 19, May 21, and June 13. Stage above top of gage, May 23-29; discharge not computed on account of numerous diversions between this station and the one at Strabane.

Monthly discharge of Teton River near Chouteau, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	86	56	67.5	4,150
November	61	56	56.2	3,340
December 1-9	56	40	46.1	1,740
April 14-30	92	56	77.1	2,600
June	1,550	280	729	43,400

SPRING CREEK NEAR STRABANE, MONT.

Location.—In NE. ¼ SE. ¼ sec. 2, T. 24 N., R. 7 W., at highway bridge half a mile southeast of buildings on Peebles ranch, and 16 miles west of Chouteau, Teton County.

Drainage area.—Not measured.

Records available.—May 30 to December 31, 1913, and April 14 to September 30, 1917.

Gage.—Vertical staff on left bank at upstream side of wagon bridge. From May 30 to December 31, 1913, the gage used was a staff on the left bank, 200 feet above the highway bridge.

Discharge measurements.—Made from bridge or by wading.

Channel and control.—Banks low; covered with grass above gage and with brush below bridge; not subject to overflow except during extreme high water. Bed composed of earth, sand, and gravel, and is fairly permanent.

Extremes of discharge.—Maximum stage recorded during year, 2.44 feet at 4 p. m. May 31 (discharge, 66 second-feet); minimum stage, 0.06 foot July 30 to August 3 (discharge, 0.9 second-foot).

1913 and 1917: Maximum stage recorded 2.44 feet at 4 p. m. May 31, 1917 (discharge, 66 second-feet); minimum discharge, 0.5 second-foot August 26, 1913.

Ice.—Stage-discharge relation not seriously affected by ice; open-channel rating applicable.

Diversions.—None.

Regulation.—None.

Accuracy.—Stage-discharge relation permanent during the year; not affected by ice. Rating curve well defined between 1 and 22 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Spring Creek near Strabane, Mont., during the year ending Sept. 30, 1917

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 14	C. S. Heidel	1.14	16.8	Sept. 17	W. A. Lamb	0.18	1.3
July 24	W. A. Lamb	.07	.96				

Daily discharge, in second-feet, of Spring Creek near Strabane, Mont., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1		23	52	4.0	0.9	1.5	16	12.5	12.1	15.8	1.7	1.1	1.5
2		29	35	3.8	.9	1.5	17	12.1	10.9	19	1.7	1.1	1.5
3		33	29	3.6	.9	1.5	18	12.1	8.4	23	1.5	1.1	1.4
4		33	31	3.5	1.0	1.5	19	15.8	7.7	22	1.5	1.2	1.4
5		20	29	3.1	1.0	1.5	20	26	15.8	18	1.4	1.2	1.4
6		20	23	2.9	1.1	1.7	21	29	26	15.8	1.4	1.2	1.4
7		19	14.8	2.7	1.1	1.7	22	28	23	13.7	1.2	1.2	1.5
8		19	13.3	2.5	1.2	1.5	23	24	19	10.8	1.2	1.2	1.5
9		18	13.1	2.3	1.2	1.5	24	23	17	8.4	1.1	1.1	2.3
10		18	39	2.2	1.4	1.5	25	18	64	6.6	1.0	1.1	2.5
11		13.7	47	2.0	1.4	1.5	26	19	35	5.0	1.0	1.1	2.7
12		13.3	33	2.0	1.2	1.4	27	19	29	4.8	1.0	1.2	2.5
13		12.9	24	1.8	1.2	1.4	28	20	45	4.3	1.0	1.2	2.7
14	17	12.9	20	1.8	1.2	1.4	29	20	64	4.0	1.0	1.4	2.7
15	12.9	12.9	17	1.8	1.1	1.5	30	23	59	4.0	.9	1.4	2.7
							31		64		.9	1.4	

Monthly discharge of Spring Creek near Strabane, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
Apr. 14-30	29	12.1	19.5	658
May	64	7.7	25.7	1,580
June	52	4.0	19.8	1,180
July	4.0	.9	1.92	118
August	1.4	.9	1.16	71
September	2.8	1.4	1.75	104
The period				3,710

SPRING CREEK NEAR CHOUTEAU, MONT.

Location.—At McDonald's ranch, near east line of sec. 33, T. 25 N., R. 6 W., half a mile above mouth and 13 miles northwest of Chouteau, in Teton County.

Records available.—April 13 to September 30, 1917.

Drainage area.—Not measured.

Gage.—Vertical staff with enamel face, on right bank 100 feet below wagon bridge; read by Roland Brooks and Katherine McDonald.

Discharge measurements.—Made by wading or from the bridge 100 feet above the gage.

Extremes of discharge.—Maximum stage recorded during year, 3.35 feet at 9 a. m., May 26 (discharge, 138 second-feet); minimum stage, 2.10 feet September 12-30 (discharge, 12.0 second-feet).

Ice.—Station not maintained during winter.

Diversions.—Several small ditches divert some water for irrigation above station; amount is small.

Regulation.—None.

Accuracy.—Stage-discharge relation not permanent. Rating curve used, April 13 to August 23 well defined between 10 and 40 second-feet. Shifting-control method used August 24 to September 30. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good, April 13 to August 23; fair, August 24 to September 30.

Discharge measurements of Spring Creek near Chouteau, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 13	C. S. Heidel	2.35	32.7	July 24	W. A. Lamb	2.09	14.6
July 2	W. A. Lamb	2.25	25.6	Sept. 17	.....do	2.08	11.8

Daily discharge, in second-feet, of Spring Creek near Chouteau, Mont., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1		37	98	15	14	15	16	26	35	42	15	15	12
2		46	71	15	15	17	17	26	33	44	15	15	12
3		47	56	15	15	14	18	26	29	56	15	15	12
4		44	56	15	15	14	19	33	31	54	15	15	12
5		42	54	15	15	14	20	33	42	46	15	15	12
6		39	54	15	15	14	21	35	56	42	15	15	12
7		35	44	15	15	13	22	33	46	37	15	15	12
8		35	44	15	15	13	23	33	44	33	15	15	12
9		35	56	15	15	13	24	35	39	31	15	15	12
10		35	54	15	15	13	25	33	87	31	15	15	12
11		33	76	15	15	12	26	33	138	31	15	14	12
12		33	71	15	15	12	27	37	87	31	15	14	12
13	33	33	56	15	15	12	28	33	104	29	15	14	12
14	33	31	46	15	15	12	29	33	120	29	14	14	12
15	29	33	44	15	15	12	30	37	98	28	14	14	12
							31		98		14	14	

NOTE.—Gage not read; discharge interpolated Apr. 17, May 28, July 7 and 22.

Monthly discharge of Spring Creek near Chouteau, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 13–30	37	26	32.3	1,150
May	138	29	53.1	3,260
June	98	28	48.1	2,860
July	15	14	14.9	916
August	15	14	14.8	910
September	17	12	12.7	756
The period				9,850

DEEP CREEK NEAR CHOUTEAU, MONT.

LOCATION.—In SW. ¼ NW. ¼ sec. 15, T. 23 N., R. 5 W., at Hugh Robinson's ranch, 5 miles southwest of Chouteau, in Teton County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—March 24, 1911, to September 30, 1917.

GAGE.—Overhanging chain on right bank, 400 feet above Hugh Robinson's house; read by Hugh Robinson.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Bar of gravel 50 feet below gage forms principal control. Channel clean and fairly permanent. Right bank high and not subject to overflow; left bank may be overflowed.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.1 feet at 8 a. m. May 26 (discharge, 1,930 second-feet); minimum stage recorded, 5.3 feet March 8, 9, 11–15, 17, 19, 22–26 (discharge, 12 second-feet).

1911–1917: Maximum stage recorded, 10.5 feet, 7 a. m. June 21, 1916 (discharge, from extension of rating curve, 3,050 second-feet); minimum stage recorded, 5.28 feet, September 25, 1913, and 5.27 feet, September 6, 1914 (discharge, 11 second-feet).

ICE.—Stage-discharge relation seriously affected by ice after December 5; observations discontinued December 24 to March 7; flow interpolated November 10–13 on account of ice.

DIVERSIONS.—A few small ditches divert from creek above gage.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during high water in May and June; affected by ice. Daily gage heights are from observer's readings to nearest half-tenth once daily. Daily discharge ascertained by applying to daily gage heights for October 1 to November 9, November 14 to December 5, and March 8 to June 24 a rating table well defined below 700 second-feet and fairly well defined above. Daily discharge for the period June 25 to September 30 obtained as above by means of a rating table based upon a curve fairly well defined.

Discharge measurements of Deep Creek near Chouteau, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 19	7.25	512
July 24	5.70	66

Daily discharge, in second-feet, of Deep Creek near Chouteau, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	67	58	44		107	130	1,530	270	54	49
2	58	67	44		118	142	1,060	237	54	49
3	76	58	51		76	244	835	237	54	49
4	67	67	44		96	212	706	237	54	49
5	96	67	51		182	168	646	222	60	49
6	107	58			244	182	588	207	60	49
7	96	58			168	227	588	194	54	49
8	107	44		12	260	227	706	180	66	49
9	96	67		12	196	227	770	168	66	54
10	107	65		17	118	227	835	168	66	54
11	107	63		12	96	296	980	156	60	54
12	86	61		12	118	356	835	145	60	49
13	96	59		12	96	426	532	134	54	44
14	76	58		12	76	426	452	134	54	49
15	76	86		12	58	588	478	124	49	49
16	76	58		17	38	646	532	114	49	44
17	67	51		12	28	532	617	105	49	44
18	76	67		14	38	378	646	105	49	44
19	76	76		12	44	335	532	96	49	44
20	107	96		14	76	335	532	88	49	40
21	142	67		14	118	706	505	73	49	40
22	118	67		12	212	588	478	73	44	40
23	107	76		12	142	478	426	66	44	40
24	96	86		12	142	378	378	66	40	73
25	96	51		12	107	770	343	66	40	73
26	96	67		12	142	1,930	324	66	44	54
27	76	96		17	118	1,290	305	66	44	49
28	86	86		196	44	1,060	288	60	40	44
29	67	76		706	44	1,690	270	54	40	44
30	76	67		426	96	1,530	270	54	44	36
31	76			182		1,370		54	49	

Monthly discharge of Deep Creek near Chouteau, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	142	58	88.9	5,470
November	96	44	67.4	4,010
December 1-5	51	44	46.8	464
March 8-31	706	12	73.8	3,510
April	244	28	113	6,730
May	1,930	130	584	35,900
June	1,530	270	600	35,700
July	270	54	130	7,990
August	66	40	51.4	3,160
September	73	36	48.5	2,890

WILLOW CREEK NEAR CHOUTEAU, MONT.

LOCATION.—In sec. 14, T. 23 N., R. 6 W., at McPhee's ranch, 12 miles southwest of Chouteau, in Teton County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 2, 1912, to September 30, 1917.

GAGE.—Staff gage on left bank, half a mile below house of S. A. McPhee; read by S. A. McPhee.

DISCHARGE MEASUREMENTS.—Made by wading at gage, except at extremely high stages, when they may be made from bridge half a mile below gage.

CHANNEL AND CONTROL.—A gravel bar 30 feet below gage is the control; shifts occasionally. Banks are about 4 feet high and are overflowed only at extreme flood stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.60 feet at 1.20 p. m. May 26 (discharge, 663 second-feet); minimum stage, 1.13 feet August 25 and 30 (discharge, 0.4 second-foot).

1912-1917: Maximum stage recorded, 6.60 feet June 21, 1916 (discharge, 880 second-feet); minimum stage, dry July 20 to end of season, 1914.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter; probably little flow.

DIVERSIONS.—Several small diversions above station, mostly to water hay land; very little water used except during very dry periods.

REGULATION.—None.

ACCURACY.—Stage-discharge relation fairly permanent during year; apparently not seriously affected by aquatic growths this year. Rating curve well defined between 3 and 400 second-feet. Gage read to quarter-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good.

Discharge measurements of Willow Creek near Chouteau, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 19	2.49	96
July 24	1.42	4.2

Daily discharge, in second-feet, of Willow Creek near Chouteau, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	24	21	26	117	60	615	26	0.8	0.8
2	26	21	23	108	84	548	90	.8	1.7
3	30	20	21	78	103	358	72	.7	2.2
4	34	20	21	52	120	283	54	1.4	3.0
5	30	20	23	90	114	247	43	2.0	3.5
6	32	20	23	97	179	208	33	2.6	3.5
7	39	21	24	101	233	195	24	3.2	3.5
8	34	23	24	103	258	203	19	5.3	3.5
9	30	23	23	90	244	212	16	7.7	4.4
10	34	21	23	68	233	454	15	12	5.9
11	30	23	23	60	247	358	14	13	5.9
12	29	23	23	54	244	212	14	9.7	5.9
13	26	26	23	52	238	179	12	7.7	6.5
14	24	29	23	48	238	155	12	5.3	6.5
15	23	30	23	41	265	117	9.7	3.5	6.5
16	20	34	....	33	212	110	8.1	3.2	5.9
17	20	37	....	26	166	90	7.7	2.6	5.9
18	23	39	....	32	147	78	5.9	2.2	5.3
19	26	34	....	38	124	90	5.3	2.0	5.3
20	30	32	....	45	212	84	4.4	1.7	4.4
21	32	30	....	43	377	78	4.4	1.4	4.4
22	37	30	....	90	247	72	4.4	1.0	3.5
23	34	29	....	124	192	66	3.5	.8	4.4
24	32	26	....	97	377	54	4.1	.7	4.4
25	30	24	....	72	596	63	3.0	.4	5.3
26	29	23	....	68	663	43	2.6	.8	5.9
27	26	23	....	66	596	43	2.2	.7	5.9
28	26	24	....	57	377	38	2.0	.7	5.3
29	24	26	....	48	452	35	1.7	.7	5.3
30	23	29	....	43	514	35	1.4	.4	4.4
31	23	....	....	....	470	....	1.0	.7	....

NOTE.—Gage not read Dec. 16 to Mar. 31.

Monthly discharge of Willow Creek near Chouteau, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	39	20	28.4	1,750
November	39	20	26.0	1,550
December 1-15	26	21	23.1	687
April	124	26	67.9	4,040
May	663	60	277	17,000
June	615	35	177	10,500
July	90	1.0	16.6	1,020
August	13	.4	3.09	190
September	6.5	.8	4.63	276

MUDDY CREEK NEAR BYNUM, MONT.

LOCATION.—In NW. ¼ SE. ¼ sec. 22, T. 26 N., R. 6 W., 400 feet above mouth of Blackleaf Creek and 2 miles above Bynum, in Teton County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 24, 1912, to September 30, 1917.

GAGE.—Vertical staff on right bank; read by George Miller. June 23, 1916, a temporary vertical staff was set about 20 feet downstream to replace regular gage, which had been washed out. July 21, 1916, new low-water staff was set at regular section. Prior to October 5, 1914, gage in use was overhanging chain on left bank 100 feet upstream from present gage, and at different datum.

CHANNEL AND CONTROL.—Stream bed sand and gravel; may shift. Left bank high and not subject to overflow; right bank gradually sloping; apparently one channel at all stages.

Extremes of discharge.—Maximum stage recorded during year, 5.90 feet at 7.50 a. m. May 26 (discharge, 720 second-feet); minimum stage, 2.30 feet September 1–24 (discharge, 1.0 second-feet).

1912–1917: Maximum stage recorded, 6.9 feet June 21, 1916, determined by leveling from flood marks (discharge, determined from extension of rating curve, 976 second-feet); channel dry August 18, 23, 24, 31; September 1–3, 10, 29; and October 7, 1912.

Ice.—Ice present November 9–11; discharge not computed; no readings, November 12, to April 1.

Diversions.—Three small ditches divert above the station, and the Teton Cooperative Co. proposes to store the flood waters.

Regulation.—None.

Accuracy.—Stage-discharge relation not permanent, owing to shifting control and ice. Rating curve used October 1 to November 8 well defined below 600 second-feet; curve used April 2 to May 20 poorly defined; June 7 to September 30, fairly well defined; shifting-control method used May 21–29. Gage read to quarter-tenths twice daily April 20 to June 10, and once daily during rest of year. Daily discharge ascertained by applying daily gage height to rating table. Records good.

Discharge measurements of Muddy Creek near Bynum, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 13	C. S. Heidel	3.25	31.9	July 23	W. A. Lamb	2.35	2.1
June 8	W. A. Lamb	3.48	108	Sept. 16	.....do	2.30	.5
July 2	.....do	27.2	17.9				

Daily discharge, in second-feet, of Muddy Creek near Bynum, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	4.0	7.2	....	51	290	24	1.9	1.0
2	4.0	8.0	90	58	330	20	1.9	1.0
3	6.4	8.0	84	54	220	20	1.9	1.0
4	7.2	8.0	80	67	150	20	1.9	1.0
5	12	8.0	84	42	120	16	1.9	1.0
6	24	9.0	88	42	100	13	1.9	1.0
7	31	7.2	88	42	89	10	1.9	1.0
8	26	7.2	71	42	100	7.9	1.9	1.0
9	20	....	71	33	105	7.9	1.9	1.0
10	19	....	62	33	127	5.8	1.9	1.0
11	18	....	59	29	258	5.8	1.9	1.0
12	16	....	53	29	216	5.8	1.9	1.0
13	13	....	33	37	110	4.3	1.9	1.0
14	12	....	23	29	81	5.8	1.9	1.0
15	10	....	16	37	74	4.3	1.9	1.0
16	9	....	8	42	67	2.8	1.9	1.0
17	9	....	6	42	74	2.8	1.9	1.0
18	10	....	7	42	74	2.8	1.9	1.0
19	13	....	22	33	67	2.8	1.9	1.0
20	13	....	70	37	67	2.8	1.9	1.0
21	10	....	83	260	74	2.8	1.9	1.0
22	19	....	62	135	61	2.8	1.0	1.0
23	20	....	54	80	61	2.8	1.0	1.0
24	19	....	42	65	44	2.8	1.0	4.3
25	16	....	37	145	38	2.8	1.0	1.0
26	13	....	48	720	38	2.8	1.0	1.0
27	13	....	48	200	33	2.8	1.0	1.0
28	12	....	8	175	33	1.9	1.0	1.0
29	12	....	26	185	28	1.9	1.0	1.0
30	10	....	29	300	24	1.9	1.0	1.0
31	9	....	....	290	....	1.9	1.0	....

Note.—Discharge, May 30 to June 6, determined from records of flow of Blackleaf Creek for same period on basis of comparisons for preceding and following periods.

Monthly discharge of Muddy Creek near Bynum, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	31	4.0	13.9	855
November 1-8	9.0	7.2	7.83	124
April 2-30	90	6	50.1	2,880
May	720	29	109	6,700
June	330	24	105	6,250
July	24	1.9	6.83	420
August	1.9	1.0	1.61	99
September	4.3	1.0	1.11	66

NOTE.—See footnote to daily discharge table regarding discharge May 30 to June 6, 1917.

MUDDY CREEK NEAR AGAWAM, MONT.

LOCATION.—In sec. 35, T. 26 N., R. 4 W., at highway bridge 2 miles southeast of Agawam, in Teton County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—June 17 to September 30, 1917, when station was discontinued.

GAGE.—Wire gage on the downstream handrail of bridge near left bank, read by Wm. Moser.

DISCHARGE MEASUREMENTS.—Made by wading or from highway bridge.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.18 feet June 17 (discharge, 150 second-feet); minimum stage, 1.50 feet September 20 (discharge, 9 second-feet).

ICE.—Station not maintained during winter.

DIVERSIONS.—Several ditches divert water for irrigation above station.

REGULATION.—Flow increased by Teton Cooperative Reservoir.

ACCURACY.—Stage-discharge relation changed July 1-17. Rating curve used June 17 to July 1 well defined below 152 second-feet; curve used July 18 to September 30 well defined between 8 and 109 second-feet; shifting-control method used July 2-17. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good, except those for July 2-17, which are fair.

Discharge measurements of Muddy Creek near Agawam, Mont., during the period June 17 to Nov. 8, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec. ft.*			*Feet.*	*Sec. ft.*
June 17	W. A. Lamb	3.18	150	Aug. 22	W. A. Lamb	2.27	50
28	....do	2.33	66	Sept. 16	....do	1.62	11.9
July 23	....do	2.1	39.9	Nov. 8	Lamb and Jones	1.65	19.0

Daily discharge, in second-feet, of Muddy Creek near Agawam, Mont., for the year ending Sept. 30, 1917.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1		49	57	36	16		30	60	12
2		43	57	41	17	150	39	60	12
3		41	56	30	18	145	49	56	11
4		38	57	28	19	136	50	55	10
5		34	66	28	20	127	48	44	9
6		31	65	27	21	132	44	50	10
7		25	67	24	22	127	45	48	12
8		27	69	17	23	105	39	50	29
9		19	70	21	24	90	39	52	51
10		29	68	24	25	81	37	48	34
11		41	69	20	26	74	38	43	40
12		39	66	14	27	70	37	30	29
13		39	63	13	28	63	41	29	19
14		30	61	12	29	56	50	35	13
15		31	60	13	30	53	58	41	10
					31		59	30	

Monthly discharge of Muddy Creek near Agawam, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
June 17–30	150	53	101	2,800
July	59	19	39.3	2,420
August	70	29	54.3	3,340
September	51	9	21.6	1,290
The period				9,850

BLACKLEAF CREEK NEAR BYNUM, MONT.

LOCATION.—In NW. ¼ SE. ¼ sec. 22, T. 26 N., R. 6 W., 200 feet above mouth of creek and 2 miles above Bynum, in Teton County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 24, 1912, to September 30, 1917.

GAGE.—Overhanging chain gage on left bank, 100 feet west of an abandoned barn: read by George Miller.

DISCHARGE MEASUREMENTS.—Made by wading near gage.

CHANNAL AND CONTROL.—Banks fairly high, and not subject to overflow. Stream bed fine sand and gravel; shifts occasionally.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.0 feet May 26 (discharge, 333 second-feet); minimum stage recorded, 2.78 feet July 31, August 1–4 and 26 (discharge, 0.1 second-feet).

1912–1917: Maximum stage recorded, 5.85 feet June 21, 1916, determined by leveling from flood marks (discharge, determined from extension of rating curve, 600 second-feet); channel dry July 21 to October 3, 1914.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

DIVERSIONS.—Most of flow at low stages is diverted above station for irrigation, and Teton Cooperative Reservoir Co. proposes to use the flood waters.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during April and May. Rating curve used October 1 to November 7 well defined below 400 second-feet; shifting-control method used April 3 to June 2; curve used June 3 to September 30 well defined below 100 second-feet. Gage read to quarter-tenths once daily; occasionally twice daily. Daily discharge ascertained by applying daily gage height to rating table. Records good, October 1 to November 7 and after June 2; fair, April 3 to June 3.

Discharge measurements of Blackleaf Creek near Bynum, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 13	C. S. Heidel	3.53	27.7	July 23	W. A. Lamb	2.88	[a] 0.5
June 8	W. A. Lamb	4.00	83	Sept. 16	.....do	2.99	1.3
July 2	.....do	3.33	18.9				

[a] Estimated.

Daily discharge, in second-feet, of Blackleaf Creek near Bynum, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	16	16	....	80	300	16	0.1	1.0
2	15	16	....	84	319	16	.1	1.0
3	16	18	233	75	223	14	.1	.8
4	13	16	230	107	140	16	.1	1.3
5	21	16	210	84	101	16	.1	1.3
6	33	16	114	86	92	16	.4	1.3
7	38	15	103	114	83	12	.6	1.3
8	40	....	83	210	83	9.9	.8	1.3
9	36	....	57	103	83	11	1.3	1.3
10	31	....	57	80	114	9.9	.5	1.5
11	29	....	36	72	120	8.2	.8	1.3
12	29	....	40	66	292	6.6	.8	1.3
13	27	....	33	72	304	6.6	.8	1.3
14	25	....	26	69	144	9.9	.6	1.3
15	22	....	18	80	138	5.5	.6	1.3
16	18	....	9.5	75	81	4.7	.5	1.3
17	18	....	10	63	87	3.5	.5	1.3
18	20	....	14	52	81	2.3	.5	1.3
19	20	....	40	49	77	1.5	.5	1.3
20	20	....	94	52	30	1.3	.5	1.0
21	18	....	72	294	25	1.3	.4	.8
22	29	....	77	155	24	1.0	.2	.8
23	31	....	83	91	24	1.0	.1	.8
24	29	....	66	78	23	.8	.1	11.0
25	25	....	64	105	23	.8	.1	6.6
26	22	....	83	323	20	.8	.1	2.3
27	22	....	88	162	18	.8	.1	1.3
28	22	....	45	122	18	.5	.5	1.3
29	20	....	28	191	16	.5	.6	1.0
30	20	....	49	303	16	.4	.5	1.0
31	20	....	....	300	....	.1	1.0	....

Monthly discharge of Blackleaf Creek near Bynum, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	40	13	24.0	1,480
November 1-7	18	15	16.1	224
April 3-30	233	9.5	73.7	4,090
May	323	49.	122	7,500
June	319	16	103	6,130
July	16	.1	6.29	387
August	1.3	.1	.45	27.7
September	11	.8	1.72	102.0

MUSSELSHELL RIVER BASIN.

MUSSELSHELL RIVER AT HARLOWTON, MONT.

LOCATION.—In sec. 26, T. 8 N., R. 15 E., at highway bridge 1 mile south of Harlowton, Meagher County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—July 11, 1907, to September 30, 1917.

GAGE.—Chain gage on upstream side of public highway bridge; read by W. G. Yamamoto. Before October, 1908, a staff gage fastened to the center pier of old highway bridge was read. April 10, 1909, a temporary staff gage was installed which read 0.73 foot high. This gage was used until May 24, 1909, when gage was lowered and the datum changed, so that the difference between the bench mark and the zero of the gage is 0.52 foot greater than formerly. No change has been made in gage or datum since May 24, 1909.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Stream bed composed of sand and gravel; bar or ridge crosses the stream about 75 feet below the gage; shifts. Banks fairly high and probably not subject to overflow. Water confined to one channel under bridge, owing to road fill at the ends.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.3 feet at 8 a. m. May 27 (discharge, 4,020 second-feet); minimum stage, 0.52 foot August 30 (discharge, 43 second-feet).

1907-1917: Maximum stage recorded, 5.3 feet at 8 a. m. May 27, 1917 (discharge, 4,020 second-feet); minimum stage recorded, dry August 4-11, 1910.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

DIVERSIONS.—Numerous ditches divert from headwater streams, and from Musselshell River above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during April. Rating curve used October 1 to December 23 and April 26 to September 30 well defined above 40 second-feet. Shifting-control method used April 1-25. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage heights to rating table. Records fair.

Discharge measurements of Musselshell River at Harlowton, Mont., during the year ending Sept. 30, 1917.

[Made by C. S. Heidel.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Apr. 7	0.90	123
June 21	3.90	2,400

Daily discharge, in second-feet, of Musselshell River at Harlowton, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	56	84	78	72	310	2,680	1,360	86	48
2	62	84	86	76	329	2,500	1,220	76	52
3	78	84	86	80	425	2,390	1,090	68	53
4	88	84	80	95	555	2,600	1,030	76	53
5	84	84	78	100	543	2,960	988	88	56
6	84	84	70	107	524	2,740	876	90	60
7	90	86	68	124	673	2,480	830	90	62
8	93	88	66	127	838	2,520	785	86	65
9	100	84	62	156	988	3,000	778	84	65
10	100	84	60	209	1,160	3,420	750	78	68
11	100	78	62	256	1,450	3,780	701	72	70
12	93	84	65	278	1,710	3,060	632	68	76
13	93	107	60	300	1,970	2,780	543	68	88
14	88	149	60	292	2,260	2,480	470	68	107
15	88	170	59	247	2,570	2,390	414	65	112
16	88	142	56	189	2,830	2,480	363	60	115
17	93	112	56	156	3,120	2,720	324	60	115
18	93	100	60	146	2,490	2,870	287	56	110
19	98	124	60	163	2,080	2,660	256	54	107
20	93	118	60	193	2,370	2,480	221	53	102
21	88	110	60	238	2,960	2,380	201	53	100
22	88	100	60	348	2,520	2,300	181	53	100
23	88	78	60	868	2,220	2,170	177	53	98
24	88	70	....	792	1,950	2,050	170	53	93
25	88	68	....	822	2,320	1,980	156	53	100
26	88	65	....	743	3,440	1,890	156	52	107
27	88	60	....	482	3,730	1,690	156	51	110
28	88	59	....	363	3,000	1,590	146	51	112
29	88	60	....	315	3,080	1,530	130	47	112
30	84	68	....	305	3,300	1,450	115	43	112
31	84	....	....	....	2,940	....	98	47	....

NOTE.—Gage not read Dec. 24 to Mar. 31.

Monthly discharge of Musselshell River at Harlowton, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	100	56	87.8	5,400
November	170	59	92.3	5,490
December 1-23	86	56	65.7	3,000
April	868	72	288	17,100
May	3,730	310	1,960	121,000
June	3,780	1,450	2,470	147,000
July	1,360	98	503	30,900
August	90	43	64.6	3,970
September	115	48	87.6	5,210

FLATWILLOW CREEK NEAR FLATWILLOW, MONT.

LOCATION.—In sec. 23, T. 12 N., R. 25 E., at Flatwillow Ranch Co.'s ranch, 8 miles above Flatwillow, Fergus County, and 30 miles north of Roundup.

DRAINAGE AREA.—200 square miles (measured on 1916 map of Fergus County).

RECORDS AVAILABLE.—May 1, 1911, to September 30, 1917.

GAGE.—Vertical staff just below wagon bridge near the ranch buildings; read by J. D. Brinegar.

DISCHARGE MEASUREMENTS.—Made from footbridge at house, or by wading at ford below house.

CHANNEL AND CONTROL.—Banks high and thickly overgrown with willows. Stream bed earth; current sluggish; weeds grow in bed during summer; control shifts.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 9.0 feet, estimated by observer June 4–11 (discharge, 454 second-feet in creek and 500 second-feet additional in canal); minimum stage recorded, 2.45 feet October 13–16 (discharge, 26 second-feet).

1911–1917: Maximum stage recorded 9.0 feet, estimated by observer June 4–11, 1917 (discharge, 454 second-feet in creek and 500 second-feet additional in canal); minimum stage 2.1 feet September 3, 4, 1912 (discharge, 1.0 second-foot).

ICE.—Stage-discharge relation seriously affected by ice; data inadequate to warrant estimates of winter flow.

DIVERSIONS.—Numerous above gage. The diversion canal of the Flatwillow Carey project heads about 3 miles upstream from the station. The wooden head gate washed out, allowing considerable water to pass through the canal without ever passing gage. This is listed under "Overflow in Flatwillow canal."

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed by ice conditions which prevailed November 11 to April 10. Rating curve used to June 4 well defined below 100 second-feet and fairly well defined above that stage. Rating curve used June 21 to September 30 fairly well defined. Canal discharge can be considered at best as only fair, because of the indirect methods used in deriving them. Creek gage read to half-tenths daily. Daily discharge of creek ascertained by applying daily gage height to rating table. Total daily discharge May 12 to September 30 obtained by adding daily discharge of creek to discharge of canal. Records good, except May 12 to about September 30, for which period they are fair.

Discharge measurements of Flatwillow Creek near Flatwillow, Mont., during the year ending Sept. 30, 1917.

[Made by C. S. Heidel.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Apr. 6	3.8	[a]50
June 23	6.1	[b]245

[a] Estimated; current-meter measurement could not be made because of ice.
[b] Total flow of creek includes additional 207 second-feet flowing down canal and which did not pass gage.

Daily discharge, in second-feet, of Flatwillow Creek near Flatwillow, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	28	28	50	104	396	164	57	44
2	30	28	50	98	415	157	52	44
3	30	26	50	93	434	157	48	44
4	32	26	50	110	454	151	44	44
5	30	28	50	116	454	151	40	44
6	28	28	50	110	454	145	40	44
7	28	26	50	110	454	139	36	44
8	28	26	50	140	454	139	36	44
9	30	28	50	173	454	133	40	44
10	28	28	50	201	454	133	44	44
11	28	....	88	215	437	127	44	46
12	28	....	82	285	419	121	44	46
13	26	....	88	327	402	115	48	48
14	26	....	93	358	384	109	48	48
15	26	....	77	406	367	104	44	52
16	26	....	67	406	349	98	44	52
17	28	....	77	358	332	93	44	52
18	28	....	88	334	314	87	44	48
19	30	....	88	327	297	87	48	48
20	28	....	77	320	279	87	48	48
21	30	....	77	342	262	82	44	44
22	28	....	82	358	245	82	44	44
23	28	....	88	342	245	82	44	44
24	30	....	93	327	238	77	44	44
25	30	....	98	327	224	77	44	48
26	28	....	104	320	210	72	44	48
27	28	....	98	320	190	67	44	48
28	28	....	104	334	183	62	44	48
29	28	....	110	342	177	62	44	44
30	30	....	110	358	170	57	44	44
31	30	....	....	377	....	57	44	....

Daily discharge, in second-feet, of overflow in Flatwillow canal near Flatwillow, Mont., for the year ending Sept. 30, 1917.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1	....	422	71	3	3	16	436	358	3	3	3
2	....	448	60	3	3	17	372	335	3	3	3
3	....	473	48	3	3	18	337	309	3	3	3
4	....	500	37	3	3	19	327	285	3	3	3
5	....	500	25	3	3	20	318	258	3	3	3
6	....	500	14	3	3	21	347	232	3	3	3
7	....	500	3	3	3	22	372	207	3	3	3
8	....	500	3	3	3	23	347	192	3	3	3
9	....	500	3	3	3	24	327	178	3	3	3
10	....	500	3	3	3	25	327	164	3	3	3
11	....	476	3	3	3	26	318	150	3	3	3
12	267	453	3	3	3	27	318	133	3	3	3
13	327	430	3	3	3	28	337	116	3	3	3
14	372	407	3	3	3	29	347	99	3	3	3
15	436	382	3	3	3	30	372	82	3	3	3
						31	396	....	3	3	....

Daily discharge, in second-feet, of Flatwillow Creek and canal near Flatwillow, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	28	28	50	104	818	235	60	47
2	30	28	50	98	863	217	55	47
3	30	26	50	93	907	205	51	47
4	32	26	50	110	954	188	47	47
5	30	28	50	116	954	176	43	47
6	28	28	50	110	954	159	43	47
7	28	26	50	110	954	142	39	47
8	28	26	50	140	954	142	39	47
9	30	28	50	172	954	136	43	47
10	28	28	50	201	954	136	47	47
11	28	....	88	215	913	130	47	49
12	28	....	82	552	872	124	47	49
13	26	....	88	654	832	118	51	51
14	26	....	93	730	791	112	51	51
15	26	....	77	842	749	107	47	55
16	26	....	67	842	707	101	47	55
17	28	....	77	730	667	96	47	55
18	28	....	88	671	623	90	47	51
19	30	....	88	654	582	90	51	51
20	28	....	77	638	537	90	51	51
21	30	....	77	689	494	85	47	47
22	28	....	82	730	452	85	47	47
23	28	....	88	689	437	85	47	47
24	30	....	93	654	416	80	47	47
25	30	....	98	654	388	80	47	51
26	28	....	104	638	360	75	47	51
27	28	....	98	638	323	70	47	51
28	28	....	104	671	299	65	47	51
29	28	....	110	689	276	65	47	47
30	30	....	110	730	252	60	47	47
31	30	....	....	773	....	60	47	....

Monthly discharge of Flatwillow Creek near Flatwillow, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	32	23	28.5	1,750
November 1-10	28	26	27.2	540
April	110	....	76.3	4,540
May	842	93	495	30,400
June	954	252	675	40,200
July	235	60	116	7,130
August	60	39	47.4	2,910
September	55	47	49.1	2,920

NOTE.—Figures for May 12 to September 30 include estimates of flow in canal.

MILK RIVER BASIN.

SOUTH FORK OF MILK RIVER NEAR INTERNATIONAL BOUNDARY.

LOCATION.—In SW. ¼ sec. 29, T. 37 N., R. 9 W., at Richard Croff's ranch, just above Kennedy Coulee, in Teton County, 5 miles south of international boundary and 30 miles northeast of Browning.

DRAINAGE AREA.—288 square miles (measured on topographic maps).

RECORDS AVAILABLE.—April 28, 1905, to September 30, 1917.

GAGE.—Stevens water-stage recorder installed April 13, 1913, on left bank, opposite house of observer; April 28 to May 8, 1905, a staff; May 8, 1905, to Apr. 13, 1913, an overhanging chain gage. Gage read by Wm. Welch to May 31, 1917; thereby Mrs. Viola Saffell.

DISCHARGE MEASUREMENTS.—Made from cable 100 feet below gage or by wading.

CHANNEL AND CONTROL.—Bottom of channel is composed of clay and small boulders. Growth of aquatic plants affects stage-discharge relation at low stages during summer. Banks are high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.42 feet at 6 p. m., August 8 (discharge, 1,520 second-feet); minimum stage recorded 2.5 feet November 8 (discharge, 18 second-feet).

1905–1917: Maximum stage recorded 15.4 feet June 6, 1908, determined from high-water marks (discharge not computed); flood width 850 feet; flood cross section about 2,600 square feet. Minimum stage recorded, 2.9 feet August 18–20, 1906 (discharge, 1 second-foot).

ICE.—Stage-discharge relation affected by ice for short periods.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation affected by ice and shifting control. Rating curves were used directly or indirectly as follows: curve well defined between 40 and 1,520 second-feet October 1 to December 31; well defined between 21 and 1,430 second-feet January 5–10 and April 4 to September 30; and well defined between 20 and 40 second-feet January 19 to April 3. Gage heights from automatic record April 4–15, 28, May 1, 2, 5, 29, 30 and June 11–13; observer's readings used for rest of the year. Observer read to half-tenths daily to May 31, and to hundredths daily thereafter. Discharge determined by applying gage height to rating table directly October 1 to December 17, January 5–10, January 19 to April 3, April 4–10, May 17–31, June 21 to July 11, and August 9 to September 30; shifting-control method used January 11–18, April 11 to May 16, June 1–20, and July 12 to August 8. Records good.

COOPERATION.—Station maintained in cooperation with the Reclamation Service, Department of the Interior, Canada.

Discharge measurements of South Fork of Milk River near international boundary during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	Sec.-ft.			Feet.	Sec.-ft.
Nov. 16	S. H. Frame [a]	2.90	53	May 31	A. W. P. Lowrie	4.76	680
28	W. A. Lamb	2.90	62	June 16	W. A. Lamb	4.11	315
Jan. 5	H. W. Rowley [a]	2.65	27	21	A. W. P. Lowrie	3.83	273
24	do	2.80	29	29	W. A. Lamb	3.43	162
Feb. 22	G. S. Wenden [a]	2.81	33	July 11	A. W. P. Lowrie	3.12	96
Mar. 8	A. H. Tuttle	2.70	23	22	W. A. Lamb	2.86	56
15	G. S. Wenden.	2.81	32	28	A. W P. Lowrie	2.78	46
Apr. 4	A. W. P. Lowrie [a]	2.75	35	Aug. 21	W. A. Lamb	2.68	28
16	W. A. Lamb	3.87	217	26	A. W. P. Lowrie	2.62	23
May 5	A. W. P. Lowrie	3.91	267	Sept. 12	W. A. Lamb	2.70	34
17	W. A. Lamb	4.32	450				

[a] Engineer, Reclamation Service, Department of the Interior, Canada.

Daily discharge in second-feet, of South Fork of Milk River near international boundary for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	59	74	45	28	28	23	23	214	601	154	45	40
2	59	74	45	27	23	28	26	372	497	159	42	35
3	66	66	52	27	23	20	28	366	393	154	40	35
4	74	74	45	26	23	28	117	361	350	154	53	37
5	90	66	52	26	28	23	423	327	311	132	55	37
6	98	74	45	26	32	28	829	491	308	112	49	37
7	90	74	45	21	28	23	975	616	272	101	52	37
8	98	18	52	26	23	23	1,170	741	301	97	67	37
9	98	22	48	26	23	23	1,160	841	314	97	56	43
10	90	22	45	26	28	26	1,110	796	405	97	56	38
11	98	37	34	31	23	28	1,050	751	602	91	53	42
12	98	52	34	30	23	23	1,010	781	826	88	48	35
13	90	45	40	18	23	20	490	811	590	101	45	32
14	90	45	34	28	23	23	303	799	314	114	40	32
15	82	52	40	32	23	33	179	787	262	97	35	30
16	82	52	30	24	20	23	238	776	288	79	35	30
17	74	66	30	22	23	23	207	456	253	79	30	28
18	74	59	30	21	23	28	238	410	247	72	30	27
19	74	74	30	20	23	23	270	365	256	73	35	26
20	82	74	30	23	23	23	318	470	250	58	30	25
21	74	66	29	32	23	23	377	575	268	52	30	24
22	74	66	29	32	33	20	354	681	278	55	25	23
23	74	64	29	28	32	23	331	609	232	52	28	28
24	66	62	29	29	38	23	308	537	226	49	25	32
25	59	59	29	23	28	23	293	537	218	49	23	53
26	59	59	28	23	28	23	278	537	218	46	25	37
27	66	45	28	23	28	28	242	537	191	46	28	35
28	74	45	28	23	23	23	207	491	166	44	25	37
29	66	45	28	23	......	28	200	765	159	41	23	32
30	66	52	28	28	......	30	196	801	154	44	23	32
31	66	......	28	28	......	32	......	706	......	44	35	......

NOTE.—No gage-height records for the following periods: Nov. 11, Dec. 9, Feb. 19, 20, Mar. 10, 30, Apr. 3, 18, 19, 22, 23, 25, 27, 29, May 3, 7, 10, 14, 15, 18, 20, 21, 23, 25, 26, June 1, 2, July 13, Sept. 6, 7, 17, 21, 23, and 30; discharge interpolated. Discharge estimated because of ice, Nov. 23–24 and Dec. 18 to Jan. 4.

Monthly discharge of South Fork of Milk River near international boundary for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Inches.	Acre-feet.
October	98	59	77.7	0.270	0.31	4,780
November	74	18	56.1	.195	.22	3,340
December	52	28	36.1	.125	.14	2,220
January	32	18	25.8	.090	.10	1,590
February	38	20	25.7	.089	.09	1,430
March	33	20	24.8	.086	.10	1,520
April	1,170	23	431	1.50	1.67	25,600
May	841	214	591	2.05	2.36	36,300
June	826	154	325	1.13	1.26	19,300
July	159	41	84.9	.295	.34	5,220
August	67	23	38.3	.133	.15	2,360
September	53	23	34.5	.120	.13	2,050
The year	1,170	18	146	.507	6.87	106,000

MILK RIVER AT EASTERN CROSSING,[1] MONT.

LOCATION.—In NE. ¼ sec. 5, T. 37 N., R. 9 E.,[2] at international boundary, 30 miles north of Rudyard, Hill County, Mont., and 37 miles south of Many Berries, Alberta, the nearest railway stations.

DRAINAGE AREA.—2,514 square miles (measured by engineers of the Reclamation Service, Department of the Interior, Canada).

[1] Formerly called Milk River at international boundary.

[2] Station located on south side instead of north side of international boundary as given in Water Supply Paper 436.

RECORDS AVAILABLE.—April 1, 1913, to September 30, 1917. From August 7, 1909, to April 1, 1913, station was maintained by Irrigation Branch (now Reclamation Service), Department of the Interior, Canada.

GAGE.—Gurley printing gage on right (south) bank installed September 18, 1917, and used to September 30, 1917; referred to two staff gages, one inside of well and the other in trench outside. April 1, 1913, to August 13, 1913, staff gage on left (north) bank 200 feet below present gage. August 13, 1913, to March 22, 1917, Gurley printing gage referred to staff gage in river 10 feet below gage house. April 9 to June 13, 1917, several temporary gages were used, but all readings have been referred to the staff gage at the site of the one used August 13, 1913, to March 22, 1917. June 14 to September 18, readings on a staff gage at present location. The zero of the north bank gage to which readings to June 14 are referred is at elevation 2,696. 58 feet above sea level, and the present south bank gage to which readings after June 14 are referred is 2,698.92 feet above sea level.

DISCHARGE MEASUREMENTS.—Made from cable 90 feet below gage or by wading.

CHANNEL AND CONTROL.—A bar composed of heavy boulders, gravel, and sand makes a decided riffle at medium and low stages: shifts occasionally.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.60 feet, April 9 (discharge, 4,860 second-feet); minimum stage, lowest recorded discharge was that of discharge measurement of March 10, of 23 second-feet; stage-discharge relation seriously affected by ice, and lower stages may have occurred during winter.

1909–1917: Maximum stage recorded, that of April 9, 1917; minimum stage, channel recorded dry August 3–17, 22, 23, 1914.

ICE.—Stage-discharge relation seriously affected by ice November 6 to April 8.

DIVERSIONS.—None.

REGULATION.—Low-water flow materially increased by water from St. Mary canal during July, August, and September.

ACCURACY.—Stage-discharge relation affected by ice and shifting control. Rating curves as follows were used during the year: fairly well defined October 1 to November 5; fairly well defined May 1 to June 6; and well defined between 100 and 1, 600 second-feet June 15 to September 30. Gage heights from observer's readings until September 17 and from automatic gage September 17–30. Discharge ascertained by applying gage height to rating tables; shifting-control methods used April 9–30 and June 7–14. Records October 1 to November 6, May 1 to June 6, and after June 15 good; records November 7 to April 8 poor; and records April 9–30 and June 7–14 fair.

COOPERATION.—Maintained in cooperation with Reclamation Service, Department of the Interior, Canada.

Discharge measurements of Milk River at eastern crossing, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	Sec.-ft.			Feet.	Sec.-ft.
Oct. 2	Rowley and Newhall [a]	3.34	143	June 6	A. H. Tuttle	4.14	689
Nov. 2	H. W. Rowley [a]	3.35	171	13	P. A. Fetterly [a]	4.62	856
Mar. 10	A. H. Tuttle	[b] 5.13	23	14	do	[c] 3.47 [d] 5.51	1,550
Apr. 26	J. C. Milligan [a]	4.69	856				
May 7	do	4.29	820	21	A. H. Tuttle	2.38	534
9	A. H. Tuttle	4.67	1,090	July 30	P. A. Fetterly	1.70	249
15	V. A. Newhall	4.83	1,200	Aug. 3	A. H. Tuttle	1.81	258
25	A. H. Tuttle	4.32	886	Sept. 19	P. A. Fetterly	[b] 1.24	138

[a] Engineer of the Reclamation Service, Department of the Interior, Canada.
[b] Stage-discharge relation seriously affected by ice Mar. 10.
[c] South bank gage.
[d] North bank gage.

NOTE.—Prior to June 13 all measurements referred to gage on north bank at old water-stage recorder site; thereafter to gage on south bank at new water-stage recorder site.

Daily discharge, in second-feet, of Milk River at eastern crossing, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	120	172	....	1,000	512	1,320	240	264	300
2	144	171	....	900	485	946	238	264	310
3	162	182	....	800	533	908	240	267	299
4	204	193	....	700	568	870	260	270	324
5	237	204	....	600	1,330	570	280	277	313
6	262	....	....	1,500	1,200	271	300	280	313
7	245	....	....	3,500	757	505	300	277	313
8	196	....	....	4,000	713	458	306	277	318
9	181	....	....	4,860	683	437	303	277	334
10	232	....	....	4,460	1,410	520	296	283	331
11	285	....	....	3,790	1,210	596	289	299	324
12	276	....	....	3,130	1,250	528	289	347	321
13	245	....	....	3,040	1,090	870	289	328	325
14	220	....	....	2,370	1,090	1,530	286	328	328
15	204	....	....	1,220	1,140	900	289	328	255
16	212	....	....	978	1,180	809	299	328	222
17	212	....	....	705	1,220	623	306	317	210
18	204	....	....	735	1,240	492	306	310	167
19	188	....	....	735	1,300	431	296	306	116
20	188	....	....	698	1,340	380	289	299	112
21	200	....	....	839	647	375	289	293	104
22	212	....	....	824	757	380	283	293	95
23	245	....	....	713	794	350	277	286	215
24	254	....	....	1,080	847	347	273	277	165
25	228	....	....	1,080	824	339	258	280	130
26	228	....	200	817	757	321	247	280	100
27	216	....	700	632	757	296	247	280	85
28	212	....	1,400	794	832	280	247	280	77
29	196	....	1,000	691	1,100	270	252	280	79
30	192	....	1,000	633	908	241	258	283	77
31	173	....	1,050	....	946	....	258	289	....

NOTE.—Stage-discharge relation seriously affected by ice Nov. 6 to Apr. 8; flow estimated by comparison with Milk River at Milk River, Alberta, and at Havre, as follows: Nov. 6-10, 180 second-feet; 11-15, 120 second-feet; 16-30, 110 second-feet; Dec. 1-5, 110 second-feet; 6-10, 100 second-feet; 11-15, 80 second-feet; 16-20, 60 second-feet; 21-25, 50 second-feet; 26-31, 40 second-feet; Jan. 1-31, 45 second-feet; Feb. 1-28, 35 second-feet; Mar. 1-15, 35 second-feet; 16-20, 40 second-feet; 21-25, 50 second-feet. Daily flow Mar. 26-31 and Apr. 1-8 estimated as published. Flow during July, August, and part of September materially increased by flow of St. Mary canal.

Monthly discharge of Milk River at eastern crossing, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	285	120	212	13,000
November	....	....	[a] 135	8,030
December	....	....	[a] 72	4,430
January	....	....	[a] 45	2,770
February	....	....	[a] 35	1,940
March	[a] 1,400	....	[a] 204	12,500
April	4,860	600	[b] 1,590	94,600
May	1,410	485	949	58,400
June	1,530	241	575	34,200
July	306	238	277	17,000
August	347	264	292	18,000
September	331	77	222	13,200
The year	4,860	....	384	278,000

[a] Flow estimated from flow of Milk River at Milk River and at Havre. See footnote to table of daily discharge.
[b] Apr. 1-8 estimated. See footnote to table of daily discharge.

MILK RIVER AT HAVRE, MONT.

LOCATION.—In SW. ¼ SW. ¼ sec. 4, T. 32 N., R. 16 E., at highway bridge over Milk River at Havre, in Hill County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 15, 1898, to September 30, 1917.

GAGE.—Chain gage fastened to downstream rail of bridge; read by Chas. Ling, jr. Owing to shifting of bed of river, it has often been necessary to move gage from one end of bridge to the other, but the datum has not been changed.

DISCHARGE MEASUREMENTS.—Made from highway bridge or by wading.

CHANNEL AND CONTROL.—Bed of stream composed of fine gravel and sand, shifting frequently. Both banks are overflowed at high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 15.3 feet April 10 (stage-discharge relation affected by ice); maximum discharge occurred April 11 at stage 15.15 feet (discharge, 7,940 second-feet); minimum stage recorded, 5.83 feet February 13 and March 17; flow not computed on account of ice.

1898–1917: Maximum stage recorded, 17.2 feet March 12, 1916 (discharge not known); minimum stage recorded, channel recorded dry July 16–18, 1898, August 16–20, 1904, July 25, August 18–26, 1905, November 16 to December 31, 1906, July 28 to September 14, 1910, and July 29 to August 22, 1914.

ICE.—Stage-discharge relation affected by ice November 11 to April 8.

DIVERSIONS.—None.

REGULATION.—During 1917, the St. Mary canal was in operation and a total of 33,600 acre-feet was added to Milk River flow.

ACCURACY.—Stage-discharge relation affected by ice and shifting control. Rating curve well defined between 100 and 1,500 second-feet used October 1 to November 10 and April 11 to May 15; well defined between 100 and 750 second-feet used June 16 to August 18; and well defined between 100 and 400 second-feet used August 28 to September 30. Gage heights from observer's readings twice daily during open channel and three times a week during ice season. Discharge determined by applying gage heights to rating tables. Shifting-control method used May 16 to June 15 and August 18 to 27. Records good for periods covered by rating tables and fair for other periods.

Discharge measurements of Milk River at Havre, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 8	A. H. Tuttle	7.05	337	May 23	A. H. Tuttle	7.93	1,050
Nov. 5	Tuttle and Lamb	6.54	195	26	.....do	8.10	1,130
Dec. 22	W. A. Lamb	6.48	47	June 8	.....do	7.91	769
Mar. 5	A. H. Tuttle	7.61	29	19	.....do	8.01	704
31	Tuttle and Anderson	10.90	2,330	22	.....do	7.75	607
Apr. 9	A. H. Tuttle	15.17	5,020	Aug. 2	.....do	6.88	275
14	M. D. Anderson	11.90	4,410	29	Heidel and Tuttle	7.06	282
20	W. A. Lamb	8.67	1,170	Sept. 10	W. A. Lamb	7.33	381
May 5	Tuttle and Anderson	8.27	953	22	.....do	6.42	129

NOTE.—Stage-discharge relation seriously affected by ice Dec. 22, Mar. 5, Mar. 31 and Apr. 9.

Daily discharge, in second-feet, of Milk River at Havre, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	154	256	....	2,450	958	978	....	326	300
2	165	227	....	2,630	896	1,360	....	296	300
3	200	213	....	2,450	838	1,220	....	311	300
4	200	213	....	2,150	896	1,080	....	311	317
5	200	200	....	2,080	958	902	....	311	317
6	323	200	....	1,980	989	890	....	326	317
7	323	188	....	1,920	1,020	867	....	326	317
8	360	176	....	2,750	896	769	....	326	334
9	379	188	....	5,000	838	724	....	342	408
10	360	144	....	6,500	1,240	736	....	358	370
11	341	....	....	7,940	1,310	749	....	358	300
12	360	....	....	5,730	1,160	759	....	393	370
13	341	....	....	4,220	1,310	855	393	393	370
14	341	....	....	4,110	1,380	1,080	375	393	408
15	305	....	....	3,200	1,460	1,500	375	411	408
16	288	....	....	2,700	1,400	1,180	393	411	389
17	288	....	....	2,220	1,470	986	393	393	326
18	288	....	....	2,130	1,480	791	393	375	268
19	272	....	....	1,680	1,330	706	393	355	222
20	305	....	....	1,240	1,260	681	375	352	208
21	272	....	....	1,160	1,200	618	375	336	158
22	272	....	....	1,460	1,130	596	375	330	125
23	241	....	....	1,240	1,050	573	358	299	108
24	241	....	....	1,380	1,020	530	342	291	300
25	227	....	....	1,380	1,350	489	326	288	532
26	256	....	....	1,310	1,130	469	296	271	352
27	256	....	....	1,160	1,180	449	296	280	252
28	256	....	1,630	958	1,110	430	326	282	252
29	256	....	2,330	1,020	1,180	411	326	284	203
30	256	....	3,300	1,020	1,240	375	296	284	151
31	256	....	2,500	....	1,100	....	311	284	....

NOTE.—Flow not computed for period Nov. 11 to Mar. 27; gage heights reported approximately 3 times a week. Discharge Mar. 28 to Apr. 10 determined from discharge measurements of Mar. 31 and Apr. 9 and daily gage heights for period. No gage reading on following days: Apr. 19, May 6, 20, 29, June 10, 17, July 1-12, Aug. 28, Sept. 17 and 29. Flow interpolated for all, except July 1-12, which has been computed at 370 second-feet daily after comparison with Milk River at eastern crossing.

Monthly discharge of Milk River at Havre, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	379	154	277	17,000
November 1-10	256	144	200	3,970
March 28-31	3,300	1,630	2,440	19,400
April	7,940	958	2,570	153,000
May	1,480	838	1,150	70,700
June	1,500	375	792	47,100
July	393	296	360	22,100
August	411	271	332	20,400
September	532	108	300	17,900

MILK RIVER AT MALTA, MONT.

LOCATION.—In NW. ¼ sec. 17, T. 30 N., R. 30 E., at old highway bridge at Malta, in Phillips County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—July 31, 1902, to September 30, 1917.

GAGE.—Chain fastened to handrail on downstream side of bridge; read by employees of United States Reclamation Service.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed of stream composed of gravel; permanent except for slight shifts at low stages. Partial control at gage at low water, but the principal control is formed by a bar or ridge that produces a riffle considerably below the gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 19.05 feet at 9 a. m. April 6 (discharge, 10,000 second-feet); minimum stage recorded, 1.05 feet at 4 p. m. August 6 (discharge, 48 second-feet). Lower flow may have occurred during winter.

1902–1917: Maximum stage recorded, 19.75 feet, April 10, 1907 (discharge, 11,200 second-feet); channel recorded dry August 13 to November 10, 1904; April 24 to May 8, and August 30 to end of year, 1905; April 10, 27–29, May 1, 4–23, 1906; July 16 to December 8, 1910.

ICE.—Stage-discharge relation affected by ice December 6–20 and March 30 to April 5.

DIVERSIONS.—Entire run-off from drainage basin above does not pass the station for seven irrigation canals, used to irrigate about 25,000 acres of land, divert water from Milk River and its tributaries between Havre and Malta. The United States Reclamation Service has constructed a diversion dam at Dodson, 17 miles above station, which will eventually divert water to irrigate about 108,000 acres in Milk River Valley. East of Malta two canals are nearing completion, one on each side, their combined capacity will be 1,000 second-feet.

REGULATION.—Part of flood flow will be diverted into Nelson reservoir and held for use in irrigation.

ACCURACY.—Stage-discharge relation practically permanent except when affected by ice. Rating curve very well defined was used October 1 to December 5 and April 6 to September 30. Gage read to half-tenths twice daily October 1 to December 16 and March 30 to May 17, and to half-tenths once daily May 18 to September 30. Discharge determined by applying gage height to rating table. Records good.

Discharge measurements of Milk River at Malta, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 6	A. H. Tuttle	1.84	139	Apr. 20	M. D. Anderson	15.65	8,410
Dec. 20[a]	W. A. Lamb	2.16	137	21	....do	10.97	5,630
Apr. 2[a]	Anderson and Tuttle	14.60	4,240	May 19	A. H. Tuttle	6.75	3,150
5[a]	....do	16.04	5,270	June 1	....do	3.94	1,180
7[b]	....do	16.90	9,130	15	....do	3.17	713
8	....do	15.28	8,440	Aug. 8	....do	1.13	53.6

[a] Stage-discharge relation affected by ice.
[b] Surface velocities were taken on account of floating ice. Used 0.90 coefficient to reduce to mean. Sounding from measurement of Apr. 8.

Daily discharge, in second-feet, of Milk River at Malta, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	159	327	180	....	4,100	2,650	1,280	104	55	64
2	167	327	180	....	4,300	2,520	1,280	104	55	64
3	180	327	180	....	4,200	2,320	1,280	104	55	64
4	180	327	180	....	4,500	2,100	1,280	97	55	64
5	167	327	180	....	5,700	1,820	1,410	97	51	64
6	150	327	177	....	10,100	1,680	1,410	104	48	64
7	155	308	174	....	9,580	1,680	1,410	104	51	64
8	174	290	171	....	8,470	1,960	1,410	104	55	64
9	254	290	168	....	8,280	1,680	725	68	59	64
10	327	290	165	....	8,020	1,760	495	68	64	68
11	365	237	162	....	7,890	2,180	860	68	68	73
12	426	220	159	....	8,020	2,520	790	64	78	73
13	545	220	156	....	8,150	3,060	790	59	79	78
14	600	220	153	....	8,280	3,500	725	55	97	78
15	472	220	150	....	8,340	3,740	725	59	104	90
16	426	205	147	....	8,540	3,920	758	55	164	90
17	385	180	144	....	8,670	3,800	895	55	141	90
18	385	167	141	....	8,800	3,260	1,280	55	97	90
19	365	167	139	....	8,860	2,990	1,210	55	79	90
20	365	167	137	....	8,410	2,780	1,000	59	78	97
21	346	180	....	....	6,060	2,650	965	68	68	101
22	365	180	....	....	4,710	2,380	545	64	64	90
23	365	180	....	....	3,560	1,960	545	64	59	84
24	365	190	....	....	3,440	1,820	426	64	59	78
25	365	190	....	....	3,800	1,680	327	64	64	73
26	365	190	....	....	4,290	1,540	112	59	68	68
27	346	180	....	....	4,530	1,410	112	64	68	64
28	327	180	....	....	4,040	1,410	112	59	64	90
29	327	180	....	....	3,860	1,410	112	59	64	177
30	327	180	....	1,000	2,860	1,280	104	59	68	220
31	327	....	....	2,800	....	1,280	....	55	64	....

NOTE.—Discharge Dec. 6-20 interpolated and Mar. 30 to Apr. 5 estimated from measurements of Apr. 2 and 5 because of ice. No records Dec. 21 to Mar. 29.

Monthly discharge of Milk River at Matla, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	600	150	325	20,000
November	327	167	232	13,800
December 1-20	180	137	162	6,430
April	10,100	2,860	6,410	381,000
May	3,920	1,280	2,280	140,000
June	1,410	104	812	48,300
July	104	55	71.5	4,400
August	164	48	72.4	4,450
September	220	64	84.7	5,040

NOTE.—Stage-discharge relation affected by ice Dec. 6-20 and Apr. 1-5.

MILK RIVER NEAR VANDALIA, MONT.

LOCATION.—In sec. 7, T. 30 N., R. 37 E., at Vandalia dam of United States Reclamation Service, 2 miles west of Vandalia, in Valley County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 5, 1915, to September 30, 1917. Station maintained at Hinsdale, 8 miles upstream from May 13, 1908, to November 13, 1914. Discharge nearly same at both points.

GAGE.—Sloping gage painted on concrete of right abutment downstream side of dam; read by employees of United States Reclamation Service.

DISCHARGE MEASUREMENTS.—Made from bridge over crest of dam or by wading. High-water measurements prior to 1917 made from highway bridge at Vandalia, 4 miles downstream.

CHANNEL AND CONTROL.—Channel of sand and gravel. Control for medium and low stages is a gravel bar; no definite control for high stages.

EXTREMES OF DISCHARGE.—Maximum stage reported during year, 34.5 feet at 5 p. m., April 11 (discharge, 25,200 second-feet); minimum stage, 3.9 feet September 2-14 (discharge, 32 second-feet).

1908–1917: Maximum stage, that of April 11, 1917; channel recorded dry August 9–13, 1910.

ICE.—Stage-discharge relation seriously affected by ice January 1 to March 31, 1917.

DIVERSIONS.—Numerous canals divert water for irrigation from main stream and nearly all tributaries.

REGULATION.—Flow partly regulated by the diversion dams and by storage in Nelson reservoir.

ACCURACY.—Stage-discharge relation affected by ice and shifting control. Rating curves are fairly well defined for periods October 1 to June 27 and June 28 to September 30. Gage heights are subject to error when flow over crest of dam or through gates causes wave action on gage. Gage read to tenths twice daily. Daily discharge ascertained by applying gage height to rating table. Records fair.

Discharge measurements of Milk River near Vandalia, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 7	A. H. Tuttle	4.75	[b] 176	May 15	A. H. Tuttle	15.6	[c] 4,920
Dec. 21	W. A. Lamb	4.45	[d] 114	30	.....do	9.1	[c] 1,810
Jan. 27	Tuttle and Freegans [a]	4.40	[d] 83	June 13	.....do	6.70	[c] 909
Apr. 3	Anderson and Tuttle	18.0	[c d] 4,460	Aug. 7	.....do	4.30	77
19	M. D. Anderson	28.7	[c] 17,400				

[a] Engineer, United States Reclamation Service.
[b] Made from highway bridge 2½ miles below gage; poor section.
[c] Made from bridge at dam.
[d] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Milk River near Vandalia, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	144	398	188	400	6,950	1,640	116	77	40
2	144	300	188	1,800	6,510	1,730	165	92	32
3	165	300	213	4,460	6,160	1,640	165	92	32
4	176	300	240	5,500	5,620	1,600	108	92	32
5	165	300	213	6,250	5,000	1,690	108	92	32
6	188	300	240	8,300	4,260	1,730	108	92	32
7	188	300	213	11,500	3,850	1,730	144	77	32
8	213	300	200	18,000	3,600	1,640	125	77	32
9	213	300	200	21,000	3,200	1,600	108	77	32
10	240	300	176	23,700	3,800	1,560	125	77	32
11	240	300	176	25,100	3,150	1,210	108	77	32
12	300	300	188	24,500	4,000	830	108	77	32
13	365	240	188	23,700	4,100	830	92	63	32
14	432	240	188	22,800	4,590	952	92	50	32
15	870	240	188	21,700	5,120	952	77	50	36
16	570	240	188	20,600	5,760	952	77	50	40
17	500	240	144	19,500	5,820	952	165	50	40
18	535	240	144	18,200	5,820	952	165	50	36
19	678	240	144	17,300	5,620	952	144	50	92
20	754	188	144	16,600	4,940	1,040	134	63	144
21	754	188	114	15,900	4,100	1,510	108	63	144
22	754	188	114	14,400	3,850	1,380	108	63	144
23	754	188	114	11,000	3,550	1,040	92	63	125
24	716	188	114	8,200	3,150	910	92	63	125
25	716	188	114	7,800	2,790	716	77	63	108
26	716	188	114	7,880	2,520	754	77	50	108
27	642	188	114	8,460	2,350	432	77	50	108
28	570	188	114	8,620	2,170	108	77	50	108
29	570	188	114	8,370	2,040	108	77	40	108
30	570	188	114	8,040	1,860	108	77	40	108
31	398	....	114	....	1,600	....	77	40	....

NOTE.—Discharge estimated Dec. 21-31 at 114 second-feet because of ice. Apr. 1-9 daily discharge estimated from measurement of Apr. 3. Observations discontinued during January, February, and March.

Monthly discharge of Milk River near Vandalia, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	870	144	459	28,200
November	398	188	248	14,800
December	240	a 114	162	9,960
April	25,100	a 400	13,700	815,000
May	6,950	1,600	4,120	253,000
June	1,730	108	1,110	66,000
July	165	77	109	6,700
August	92	40	64.8	3,980
September	144	32	67.7	4,030

a Estimated.

NORTH FORK OF MILK RIVER NEAR INTERNATIONAL BOUNDARY.[1]

Location.—In NE. ¼ sec. 11, T. 1, R. 23 W. fourth meridian, about 300 yards above road crossing at Peters ranch, 2 miles north of international boundary and 18 miles east of Kimball, Alberta.

Drainage area.—101 square miles (measured on topographic maps).

Records available.—January 1, 1913, to September 30, 1917. July 21, 1909, to December 31, 1912, station was maintained by Irrigation Branch (now Reclamation Service), Department of Interior of Canada, in NE. ¼ sec. 13, T. 1, R. 23 W. fourth meridian, 2 miles downstream; May 8, 1911, to December 31, 1912, station was maintained at Alexander Dubray's ranch, 2 miles south of international boundary..

Gage.—Stevens water-stage recorder on left bank; W. Wheeler and Charles Barnett, observers.

Discharge measurements.—Made by wading or from footbridge 700 feet below gage.

Channel and control.—Bed of stream at gage and principal control composed of clay and small boulders; slightly shifting. Banks high and not subject to overflow at ordinary stages.

Extremes of discharge.—Maximum stage recorded during year, 3.95 feet April 9 (discharge, 482 second-feet); minimum discharge, 13.8 second-feet December 29, 1916.

1909–1917: Maximum stage recorded 3.9 feet (referred to station maintained by Canada; see paragraph on "Records available") July 27, 28, 1909 (discharge, 591 second-feet); minimum discharge, 5.0 second-feet February 12, 1916.

Ice.—Stage-discharge relation seriously affected by ice November 11 to April 8.

Diversions.—None.

Regulation.—Amount of water turned into river by St. Mary canal: July, 12,500 acre-feet; August, 15,600 acre-feet; September 1–13, 5,540 acre-feet; approximate total of 33,600 acre-feet.

Accuracy.—Stage-discharge relation affected by ice and shifting control. Rating curves were used as follows: Well defined between 40 and 65 second-feet October 1 to November 10; well defined between 86 and 500 second-feet April 9 to July 1, and August 14 to September 10; well defined between 29 and 46 second-feet September 16–30. Gage heights obtained from water-stage recorder by graphic method October 1 to November 10, April 9 to May 30, and June 21 to September 30. Gage read to half-tenths once daily November 11 to April 5, and May 31 to June 20. Discharge determined by applying gage height to rating table October 1 to November 10, April 9 to July 1, August 14 to September 10, and September

[1] Formerly called "North Fork of Milk River near Kimball, Alberta."

16–30; temperature records, observer's notes, and discharge measurements used November 11 to April 8; and shifting-control method used July 2 to August 13, and September 11–15. Records very good for periods when rating tables were used; fair for other periods.

COOPERATION.—Station maintained in cooperation with Reclamation Service, Department of the Interior, Canada.

Discharge measurements of North Fork of Milk River near international boundary during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 15	S. H. Frame [a]	2.49	[b] 53	May 4	A. W. P. Lowrie	2.64	181
16	.....do	2.41	[b] 55	5	.....do	2.44	142
Jan. 4	H. W. Rowley [a]	2.29	[b] 32	30	.....do	2.34	129
6	.....do	3.10	[b] 45	June 16	W. A. Lamb	1.99	84
23	.....do	2.49	[b] 27	21	A. W. P. Lowrie	1.96	82
Feb. 21	G. S. Wenden [a]	2.20	[b] 38	July 10	.....do	3.12	264
Mar. 14	.....do	2.22	[b] 28	20	W. A. Lamb	3.10	265
Apr. 3	A. W. P. Lowrie [a]	2.23	[b] 46	27	A. W. P. Lowrie	3.20	305
9	.....do	4.05	462	Aug. 18	W. A. Lamb	3.23	304
9	.....do	3.98	491	26	A. W. P. Lowrie	3.24	303
10	.....do	3.25	311	Sept. 15	W. A. Lamb	1.81	51
10	.....do	3.29	319	20	A. W. P. Lowrie	1.73	41
16	W. A. Lamb	2.16	101				

[a] Engineer, Reclamation Service, Department of the Interior, Canada.
[b] Stage-discharge relation seriously affected by ice.

Daily discharge, in second-feet, of North Fork of Milk River near international boundary for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	53	53	49	20	17	23	45	132	119	192	323	316
2	56	55	48	24	18	24	45	204	119	194	328	311
3	56	54	48	28	20	25	46	252	112	208	323	311
4	59	53	47	31	23	26	48	184	105	223	328	316
5	65	53	47	40	27	26	50	150	102	236	322	316
6	80	50	47	45	31	27	52	271	98	236	319	309
7	80	54	47	47	36	27	150	295	94	234	319	302
8	64	81	46	47	40	28	300	225	90	232	326	302
9	60	56	45	47	44	28	482	219	121	243	323	309
10	60	44	44	46	46	28	326	208	152	262	323	287
11	63	46	42	44	47	28	410	208	184	248	328	304
12	62	48	41	41	47	28	375	216	154	273	321	266
13	58	50	40	38	47	28	255	212	123	283	319	128
14	54	52	40	35	47	28	198	196	110	292	311	64
15	53	53	38	32	47	28	159	182	97	290	307	50
16	53	55	37	28	46	27	105	170	93	285	307	44
17	56	56	36	27	45	27	98	122	89	273	304	43
18	62	56	35	27	44	27	121	121	85	271	304	43
19	63	56	34	28	42	27	139	122	91	266	309	42
20	72	56	32	28	40	28	160	140	97	264	314	41
21	85	56	30	28	38	30	161	166	89	278	311	50
22	72	56	28	28	37	32	173	136	81	290	309	46
23	60	56	26	27	34	34	170	136	82	297	309	46
24	60	56	24	27	30	36	128	145	90	297	309	58
25	57	55	21	28	21	38	146	154	89	314	309	50
26	57	54	19	28	20	39	145	156	85	304	304	46
27	60	54	17	28	21	40	139	142	85	302	304	47
28	57	53	15.2	28	21	41	110	151	83	316	304	47
29	54	52	13.8	25	....	42	118	204	84	319	304	46
30	53	51	15	21	....	43	161	135	84	316	309	45
31	55	....	17	18	....	44	....	119	....	326	321	....

NOTE.—Gage not read on following days: Nov. 13, 14, 21–23, 29, 30, Dec. 1, Apr. 6–8, June 1, 3, 5, 7, 9, 10, 12, 14, 16, 17, and 19; discharge interpolated except for period Apr. 6–8, included in winter studies. Discharge estimated because of ice Nov. 11 to Apr. 8 from discharge measurements, temperature records, and observer's notes.

Monthly discharge of North Fork of Milk River near international boundary for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	85	53	61.3	3,770
November	81	44	54.1	3,220
December	49	13.8	34.5	2,120
January	47	18	31.9	1,960
February	47	17	34.9	1,940
March	44	23	30.9	1,900
April	482	45	167	9,940
May	295	119	177	10,900
June	184	81	103	6,130
July	326	192	270	16,600
August	328	304	315	19,400
September	316	41	153	9,100
The year	482	13.8	120	87,000

NOTE.—Stage-discharge relation affected by ice Nov. 11 to Apr. 8; discharge estimated from discharge measurements, temperature records, and observer's notes.

FORT BELKNAP CANAL NEAR CHINOOK, MONT.

LOCATION.—In SE. ¼ sec. 20, T. 33 N., R. 18 E., at highway bridge half a mile below head gates of canal on Milk River, 8 miles west of Chinook, in Blaine County.

RECORDS AVAILABLE.—June 21, 1903, to September 30, 1917.

GAGE.—Vertical staff on downstream side of first bent of piles from left bank; read by O. E. Walters. Enamel face placed May 3, 1917, with datum raised 0.62 foot at same location. Prior to 1910 gage located at highway bridge a quarter of a mile below. Gage and bridge washed out by high water of June, 1908, and new gage reinstalled June 27, 1908, at different datum within a few feet of old site.

CHANNEL AND CONTROL.—Slope is main factor in determining the flow for given gate opening, but the check weir half a mile below caused backwater at gage. Aquatic plants that grow in canal reduce velocity considerably in latter part of irrigation season.

ACCURACY.—Stage-discharge relation shifting during year. Two rating tables, well defined between 20 and 60 second-feet, were used during the year; one applicable May 6 to May 29 and July 15 to September 30, and the other May 30 to July 14. Gage read to hundredths once daily. Daily discharge determined by applying daily gage heights to rating tables. Records fair.

The water in the Fort Belknap canal is diverted from the north bank of Milk River in SE. ¼ sec. 20, T. 33 N., R. 18 E., to irrigate lands on the north side of the river. Most of water diverted is used, but it can be wasted into Lodge Creek, north of Chinook, 8 miles below the head gate. Check gates erected on the main canal to divert water into the laterals often back the water for long distances. As the gates are put up under a great variety of conditions, velocities differ widely at the same gage height during the season.

Discharge measurements of Fort Belknap canal near Chinook, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	Sec.-ft.			Feet.	Sec.-ft.
May 3	Anderson and Tuttle	[a] 0.78	12.4	June 23	A. H. Tuttle	2.14	53.0
22	A. H. Tuttle	1.47	25.5	Aug. 2	do	1.85	48.8
June 2	do	1.87	39.6	8	do	1.74	41.4
16	do	1.92	43.0				

[a] New gage installed on this date; old gage read 1.40 feet. Gates not open; flow caused by leakage through gates and surface drainage.

Daily discharge, in second-feet, of Fort Belknap canal near Chinook, Mont., for the year ending Sept. 30, 1917.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1	12	40	48	56	30	16	21	44	59	38	12
2	12	41	48	49	22	17	22	39	59	37	12
3	12	34	48	55	22	18	22	42	59	32	11
4	13	30	48	45	22	19	26	42	59	18	11
5	14	32	48	45	22	20	24	48	58	22	9.7
6	15	30	48	43	22	21	24	58	58	22	8.5
7	24	30	48	43	22	22	26	58	55	23	8.5
8	24	30	62	41	22	23	26	58	53	23	4.2
9	24	36	62	38	15	24	26	44	53	26	3.5
10	24	42	78	33	15	25	31	48	52	23	4.2
11	24	43	78	33	15	26	31	48	52	25	4.2
12	24	42	78	33	14	27	33	55	51	26	4.2
13	24	39	78	32	12	28	37	48	51	26	4.2
14	25	39	62	33	12	29	43	48	52	26	4.2
15	21	35	59	37	12	30	46	48	52	27	.5
						31	46	....	52	30	....

NOTE.—Discharge interpolated May 1, 2, 4, and 5.

Monthly discharge of Fort Belknap canal near Chinook, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
May	46	12	25.0	1,540
June	58	30	42.4	2,520
July	78	48	57.0	3,500
August	56	18	33.5	2,060
September	30	.5	12.7	756
The period				10,400

LODGE CREEK AT INTERNATIONAL BOUNDARY.

LOCATION.—In SE. ¼ sec. 12, T. 1, R. 29 W. third meridian, at Willow Creek barracks of Royal Northwest Mounted Police, 1 mile north of international boundary, in Saskatchewan, Canada, and 36 miles north of Havre, Mont.

DRAINAGE AREA.—806 square miles (measured by engineers of Reclamation Service, Department of Interior, Canada).

RECORDS AVAILABLE.—April 1 to September 30, 1917. April 25, 1910, to October 31, 1916, maintained by Irrigation Branch (now Reclamation Service), Department of Interior, Canada.

GAGE.—Inclined staff on right bank at the Willow Creek post; read by Corl. A. R. Price and William Tudgay.

DISCHARGE MEASUREMENTS.—Made from cable or by wading. Some low-water measurements made with weir.

CHANNEL AND CONTROL.—Composed of heavy boulders, gravel, and sand; shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.13 feet April 10 (discharge, 2,100 second-feet); creek dry after July 16.

ICE.—Station discontinued during winter. Stage-discharge relation affected by ice and snow April 1–17.

DIVERSIONS.—Several small ditches divert water for irrigation above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation affected by ice and shifting control. Rating curve well defined throughout and applicable April 17, 29, May 3, 8–15, 23, 30 to July 16. Gage heights are mean of readings to hundredths twice daily. Discharge determined by applying gage heights to rating table. Shifting-control method used April 7–16, 18–28, 30 to May 2, May 4–7, 16–22, and 24–29. Records fair.

COOPERATION.—Maintained in cooperation with Reclamation Service, Department of Interior, Canada.

Discharge measurements of Lodge Creek at international boundary during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 7	G. S. Wenden[a]	[b]5.30	283	May 24	A. H. Tuttle	2.35	63
17	do	[b]6.42	974	25	G. S. Wenden	2.28	65
27	do	4.32	368	30	do	2.04	29
30	do	3.85	233	June 7	A. H. Tuttle	1.82	17.5
May 4	Anderson and Tuttle	4.35	358	20	do	1.56	6.9
8	G. S. Wenden	4.82	453	22	P. A. Fetterly[a]	1.50	5.7
15	do	4.20	317	July 28	do	.70	0
17	do	3.73	174	Sept. 25	do	....	0

[a] Engineer, Reclamation Service, Department of the Interior, Canada.
[b] Stage discharge affected by ice.

Daily discharge, in second-feet, of Lodge Creek at international boundary for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Day.	Apr.	May.	June.	July.
1	0.1	160	25	0.3	16	1,560	234	10.4	0.1
2	.2	155	23	.3	17	1,090	158	8.8	.0
3	.5	206	22	.3	18	682	142	8.0	.0
4	5.0	309	22	.3	19	506	114	8.0	.0
5	198	331	22	.3	20	538	89	6.6	.0
6	193	319	21	.3	21	952	84	4.6	.0
7	284	301	18	.2	22	1,410	65	4.6	.0
8	948	447	17	.1	23	1,540	63	4.6	.0
9	1,780	613	16	.2	24	1,250	63	4.1	.0
10	2,100	654	16	.1	25	864	65	3.0	.0
11	1,480	593	16	.1	26	503	53	2.5	.0
12	1,580	547	15	.1	27	361	48	2.0	.0
13	1,500	418	14	.1	28	372	41	.6	.0
14	1,330	365	13	.1	29	381	35	.4	.0
15	1,520	323	12	.1	30	249	30	.3	.0
					31	....	28	....	.0

NOTE.—Discharge estimated Apr. 1–6 because of ice and snow. No flow after July 16.

Monthly discharge of Lodge Creek at international boundary for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April	2,100	0.1	839	49,900
May	654	28	228	14,000
June	25	.3	11.4	678
July	.3	.0	.097	6
The period				65,000

BATTLE CREEK AT INTERNATIONAL BOUNDARY.

LOCATION.—In SE. ¼ sec. 4, T. 1, R. 26 W. fourth meridian, a quarter of a mile above point where creek crosses international boundary in Saskatchewan, just across line from Buckley's ranch in United States, and 35 miles north of Chinook, Mont.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 1 to September 30, 1917.

GAGE.—Stevens water-stage recorder referred to two vertical staff gages, one in well and one outside; read by John Buckley.

DISCHARGE MEASUREMENTS.—Made from cable 45 feet below gage or by wading.

CHANNEL AND CONTROL.—Bed composed of heavy boulders with sand and gravel; not likely to shift except during extreme stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.50 feet at 9.40 a. m. April 13 (discharge, 3,200 second-feet); minimum stage recorded, 1.96 feet August 13 (discharge, 0.6 second-foot).

ICE.—Records not maintained during winter. Stage-discharge relation seriously affected by ice April 1–10.

DIVERSIONS.—Several small ditches divert water for irrigation above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent except for period April 1–10 when affected by ice. Rating curve well defined between 60 and 3,000 second-feet and fairly well defined below 60 second-feet, used April 16 to September 4; curve fairly well defined was used September 6–11. Daily gage heights determined from Stevens water-stage recorder April 16 to September 11, and from observer's readings twice daily September 12–30. Discharge determined by applying daily gage height to rating table. Discharge April 1–4 determined from the station at Nash's ranch 20 miles above; April 5–10 by interpolation between measurements of April 5 and 11; April 11–15 by computing discharge for hourly periods and averaging these discharges for each day; September 5 and 12–30 determined by shifting-control method. Records good.

COOPERATION.—Maintained in cooperation with Reclamation Service, Department of the Interior, Canada.

Discharge measurements of Battle Creek at international boundary during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 24	H. W. Rowley	2.79	61	May 11	G. S. Wenden	5.63	975
Nov. 16	.....do	[b]2.81	30	21	A. H. Tuttle	3.80	273
Apr. 5	G. S. Wenden[a]	....	56	22	G. S. Wenden	3.65	250
11	.....do	[b]6.20	886	29	.....do	3.34	168
12	Anderson and Tuttle	[b]6.85	1,680	June 3	A. H. Tuttle	3.16	129
13	G. S. Wenden	[b]8.09	2,830	17	.....do	3.05	89
21	.....do	4.79	504	26	P. A. Fetterly[a]	2.76	60
25	.....do	5.05	762	July 27	.....do	2.10	2.1
May 2	M. D. Anderson	3.83	256	Aug. 1	A. H. Tuttle	2.01	[c]1.5
4	G. S. Wenden	3.75	236				

[a] Engineer of Reclamation Service, Department of Interior, Canada.
[b] Stage-discharge relation affected by ice Nov. 16, Apr. 5, 11, 12, 13.
[c] Flow estimated.

Daily discharge, in second-feet, of Battle Creek at international boundary for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	5	311	137	42	1.0	7.4	16	1,860	516	126	30	17	21
2	15	271	133	42	.8	8.7	17	1,230	467	108	27	13	22
3	25	249	124	40	.9	8.7	18	953	417	103	32	12	19.2
4	40	249	129	42	1.1	9.4	19	718	352	95	28	13	16.5
5	56	323	129	42	1.2	10.0	20	645	306	85	23	12	15.6
6	195	349	124	42	.9	11.5	21	645	265	82	18	11	16.5
7	334	329	124	40	.9	18.3	22	764	227	74	12	10	19.2
8	473	417	122	40	.8	18.3	23	942	208	67	8.0	8.0	17.4
9	612	538	120	42	.7	19.2	24	937	182	64	8.0	5.6	30
10	751	733	115	42	.8	18.3	25	748	174	70	6.8	4.4	33
11	1,160	996	115	39	.9	16.5	26	516	172	67	5.0	3.8	28
12	1,580	1,220	112	36	.7	19.2	27	480	158	64	2.0	2.6	28
13	2,830	1,280	101	35	.6	20	28	467	156	60	1.8	2.6	28
14	2,560	1,030	106	36	1.2	28	29	446	160	54	1.4	3.2	22
15	2,610	636	128	37	12	28	30	374	152	47	1.1	5.6	23
							31	....	144	....	1.0	8.0	....

NOTE.—Discharge Apr. 1–4 determined from station at Nash's ranch 20 miles above, Apr. 5–10 by interpolation between measurements Apr. 5 and 11.

Monthly discharge of Battle Creek at international boundary for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April	2,830	5	832	49,500
May	1,280	144	419	25,800
June	137	47	99.5	5,920
July	42	1.0	25.9	1,590
August	17	.6	5.04	310
September	33	7.4	19.4	1,150
The period	....	....	....	84,300

BATTLE CREEK[1] NEAR CHINOOK, MONT.

LOCATION.—In sec. 3, T. 33 N., R. 19 E., 500 feet above new highway bridge at point 4½ miles north of Chinook, in Blaine County, 7 miles above junction with Milk River.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 22, 1905, to September 30, 1917.

GAGE.—Chain on left bank near house of R. B. Snedecor, 500 feet above the highway bridge; read by Mrs. R. B. Snedecor.

DICHARGE MEASUREMENTS.—Made by wading or from highway bridge.

CHANNEL AND CONTROL.—Sandy and shifting. Banks high and not subject to overflow. At low water principal control is sand bar below gage; no well-defined control at high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.8 feet at 7.10 p. m. April 10 (discharge, 6,380 second-feet); pool stage reported August 10 to September 9.

1905–1917: Maximum stage recorded, that of April 10, 1917; channel reported dry September 3 to October 22, 1905; July 8 to November 20, 1908; June 21 to end of year, 1910; July 22 to September 3, 1911; September 7–23, 1913; July 14 to October 4, 1914; and August 10 to September 9, 1917.

ICE.—Stage-discharge relation seriously affected by ice November 23 to April 1; observations discontinued January 1 to March 27.

[1] Decision of U. S. Geographic Board; formerly known as North Fork of Milk River.

DIVERSIONS.—Three canals, which divert about 20 second-feet, take out above the station in the United States, and several small pumping plants, which supply water for irrigating the bottom land along the valley, are also operated above the station. Below the station the Matheson and Cook canals divert water used to irrigate land in Milk River valley near the mouth of Battle Creek. For record of diversions by Cook and Matheson canals, see pages 86–87. About fifteen ditches divert water from this creek in Canada before it crosses the boundary line.

REGULATION.—None.

ACCURACY.—Stage-discharge relation affected by ice and shifting control. Rating curve well defined betweeen 40 and 700 second-feet used October 1 to November 22 and April 1–8; curve fairly well defined above 150 second-feet used April 9 to June 5; curve well defined below 100 second-feet used June 22 to August 5 and September 10–30. Gage heights from observer's readings to quarter-tenths or hundredths twice daily. Discharge determined by applying daily gage height to rating table; June 6–21 by shifting-control method. Records good.

Discharge measurements of Battle Creek near Chinook, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 5	A. H. Tuttle	1.12	50.7	May 21	A. H. Tuttle	1.85	331
Apr. 8	Tuttle and Anderson	4.88	1,080	June 4	.....do	.97	161
9	M. D. Anderson	10.75	5,390	22	.....do	.52	64
9	.....do	9.95	4,300	Aug. 1	.....do	—.42	4.8
23	.....do	4.14	992	Sept. 22	W. A. Lamb	—.18	12.2
May 11	A. H. Tuttle	4.12	869				

Daily discharge, in second-feet, of Battle Creek near Chinook, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	41	56	411	363	182	46	4.0	0
2	47	55	411	341	174	46	3.2	0
3	48	54	515	298	174	44	3.0	0
4	59	54	640	277	166	40	2.6	0
5	58	54	1,190	298	166	36	2.0	0
6	65	53	1,200	363	162	33	1.4	0
7	63	52	640	385	156	31	.8	0
8	63	52	1,030	407	152	30	.4	0
9	63	52	4,050	543	147	29	.2	0
10	63	52	5,500	692	144	28	.0	8.0
11	63	52	2,570	910	150	27	0	12
12	61	52	2,710	1,130	148	26	.0	14
13	61	52	2,020	1,340	145	25	.0	16
14	63	52	2,990	1,130	121	23	.0	16
15	63	56	3,300	920	120	22	.0	18
16	63	65	2,260	710	126	22	.0	17
17	63	70	1,380	500	112	20	.0	21
18	63	72	1,000	476	95	16	.0	21
19	63	72	765	453	88	14	.0	21
20	63	72	765	385	80	13	.0	20
21	63	72	820	341	77	12	.0	16
22	63	72	820	319	67	11	.0	12
23	62	72	925	298	60	8.8	.0	12
24	61	72	970	277	58	7.4	.0	26
25	59	70	880	247	55	6.8	.0	30
26	58	70	716	217	52	5.6	.0	31
27	58	70	548	208	50	4.6	.0	31
28	58	70	524	208	48	4.2	.0	30
29	58	70	476	208	47	3.8	.0	28
30	56	70	430	199	46	3.6	.0	28
31	56	....	....	199	....	3.4	.0	....

NOTE.—Discharge Nov. 23–30 estimated at 70 second-feet daily on account of ice. Daily discharge May 14–16 interpolated on account of no gage readings. Daily discharge Aug. 6–10 estimated flow, assuming steady fall.

Monthly discharge of Battle Creek near Chinook, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	65	41	59.6	3,670
November	72	52	61.9	3,680
April	5,500	411	1,420	84,500
May	1,340	199	472	29,000
June	182	46	112	6,660
July	46	3.4	20.7	1,270
August	4.0	.0	.57	35
September	31	.0	14.3	851

COOK CANAL NEAR CHINOOK, MONT.

Location.—In N. ½ sec. 30, T. 33 N., R. 20 E., half a mile below head gates and 3 miles east of Chinook, in Blaine County.

Records available.—April 10, 1905, to September 30, 1917.

Gage.—Vertical staff on left bank 1,000 feet above point where canal turns west and runs parallel to road; read by Adam Jamison.

Discharge measurements.—Made by wading near point where canal passes under Great Northern Railway.

Channel and control.—No well-defined control. Weeds grow in canal and frequently cause backwater.

Accuracy.—Owing to delay in making repairs to flume and head gates, very little water was used in 1917. Canal was in operation during June and July; records fair.

Canal diverts water from Battle Creek in SE. ¼ sec. 19, T. 33 N., R. 20 E., for irrigation of lands in the Milk River valley south of Milk River. Water can be wasted into Milk River at point where canal crosses river in a flume about 2 miles below gage. Flume sometimes acts as throttle when too much water is turned into canal.

Discharge measurements of Cook canal near Chinook, Mont., during the year ending Sept. 30, 1917.

[Made by A. H. Tuttle.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 18	2.48	8.2
23	2.90	14.7
July 14	2.60	9.6

Daily discharge, in second-feet, of Cook canal near Chinook, Mont., for the year ending Sept. 30, 1917.

Day.	June.	July.	Day.	June.	July.	Day.	June.	July.
1		22	11		14	21	17	0.6
2		23	12		13	22	16	.4
3		21	13	8.3	11	23	16	.1
4		20	14	8.1	9.7	24	16	
5		21	15	6.0	9.0	25	17	
6		19	16	7.9	8.1	26	17	
7		18	17	9.4	7.8	27	18	
8		17	18	7.9	6.9	28	19	
9		17	19	15	5.5	29	21	
10		15	20	18	1.8	30	22	
						31		

Monthly discharge of Cook canal near Chinook, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
June	22	6.0	14.4	514
July	23	.0	9.06	557
The period				1,070

MATHESON CANAL NEAR CHINOOK, MONT.

Location.—In NW. ¼ sec. 29, T. 33 N., R. 20 E., at farm bridge forming head gate of canal, a quarter of a mile north of main road and 3½ miles east of Chinook, in Blaine County.

Records available.—April 10, 1905, to September 30, 1917.

Gage.—Vertical staff on right bank 10 feet below head gate; read by Adam Jamison.

Discharge measurements.—Made by wading.

Channel and control.—Bed of canal is earth; no well-defined control. Aquatic plants in bottom of canal during summer may cause backwater.

Accuracy.—Stage-discharge relation permanent. Rating curve well defined below 7 second-feet and applicable June 27 to July 28. Gage heights from observer's readings to hundredths once daily. Discharge by applying gage height to rating table. Records fair.

Water is diverted from Battle Creek and used to irrigate lands on north side of Milk River valley. Water can be wasted into a small tributary of Milk River.

The following discharge measurement was made by A. H. Tuttle:

July 14, 1917: Gage height, 3.95 feet; discharge, 7.0 second-feet.

Daily discharge in second-feet, of Matheson canal near Chinook, Mont., for the year ending Sept. 30, 1917.

Day.	June.	July.	Day.	June.	July.	Day.	June.	July.
1		0.6	11		6.1	21		4.2
2		.7	12		6.8	22		3.7
3		3.0	13		7.0	23		2.3
4		3.2	14		7.2	24		2.0
5		3.7	15		7.6	25		1.5
6		5.4	16		7.2	26	0.0	1.4
7		6.4	17		6.3	27	1.8	1.1
8		7.4	18		6.9	28	2.3	.7
9		6.8	19		7.4	29	2.7	.0
10		5.1	20		5.4	30	.9	.0
						31		.0

Monthly discharge of Matheson canal near Chinook, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
June 26-30	2.7	0	1.54	15.3
July	7.6	0	4.10	252
The period				267

Note.—Canal was in operation June 27 to July 28. Canal was dry during remainder of year, except possibly during the high water in spring, when the river overflowed into the canal, but no records were obtained.

PARADISE CANAL NEAR CHINOOK, MONT.

LOCATION.—In SW. ¼ sec. 35, T. 33 N., R. 20 E., 300 feet below head gate, 30 feet below flume of Cook canal, on ranch of Rudolph Friede, 6 miles southeast of Chinook, in Blaine County, and 3 miles southwest of Zurich.

RECORDS AVAILABLE.—June, 1903, to August, 1909; and January 1, 1911, to September 30, 1917.

GAGE.—Vertical staff on left bank, 300 feet below head gate and 30 feet below flume carrying Cook canal over Paradise Valley canal; read by Rudolph Friede.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Bed of canal is earth; silt is deposited during irrigation season. Weeds grow in bottom of canal during summer. A large slough into which the canal flows a few hundred feet below gage may affect results, the height of the water in the slough possibly affecting the slope of the water surface at the gage.

ACCURACY.—Stage-discharge relation affected by shifting control. Measurements made June 23, August 1 and 9, and point of zero flow give a well-defined curve below 12 second-feet which is applicable June 5 to July 12; and July 26 to September 30. Gage read to hundredths twice daily; records June 5 to September 30. Discharge determined by applying daily gage height to rating table. Shifting-control method used July 13–25. Records good.

Paradise canal diverts water from Milk River to irrigate land on the south side of Milk River valley. No water is returned to river.

Discharge measurements of Paradise canal near Chinook, Mont., during the year ending Sept. 30, 1917.

[Made by A. H. Tuttle.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
June 23	1.63	4.1	Aug. 1	2.16	10.9
July 14	1.96	11.5	9	2.08	9.8

Daily discharge, in second-feet, of Paradise canal near Chinook, Mont., for the year ending Sept. 30, 1917.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1	....	6.8	10.6	4.3	16	0.1	9.4	8.9	2.6
2	....	6.0	11.3	5.2	17	.0	10.3	8.9	2.6
3	....	4.6	11.6	5.6	18	.0	11.8	8.7	2.4
4	....	6.8	11.6	6.5	19	.0	12.1	8.5	2.0
5	....	7.3	11.6	7.2	20	.0	11.4	9.6	1.4
6	.0	8.6	11.8	7.2	21	.0	10.2	6.9	.7
7	.0	8.6	11.8	10.2	22	.5	8.6	6.8	.0
8	.0	7.3	11.9	7.8	23	4.6	8.7	5.9	.0
9	.0	8.6	9.7	7.0	24	.8	8.5	5.8	.0
10	.0	7.7	9.9	6.8	25	.6	5.8	4.9	.0
11	.0	6.6	10.0	7.4	26	.9	7.3	4.3	8.9
12	.0	6.0	9.2	8.1	27	8.6	11.0	3.5	1.5
13	.0	9.4	9.6	4.7	28	8.1	11.4	3.2	.0
14	.0	11.5	8.2	2.4	29	8.0	11.4	4.5	.0
15	.0	10.3	8.9	2.3	30	7.0	11.3	4.7	.0
					31	....	11.0	4.2	....

Monthly discharge of Paradise canal near Chinook, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
June	2.6	0	1.51	77.9
July	12.1	4.6	8.91	548
August	11.9	3.2	8.29	510
September	10.2	0	3.83	228
The period				1,364

NOTE.—Water standing in pools June 5-15, 17-21, Sept. 22-25, and 28-30.

HARLEM CANAL NEAR ZURICH, MONT.

LOCATION.—In SW. ¼ sec. 33, T. 33 N., R. 21 E., 500 feet below head gates and 1½ miles southeast of Zurich, in Blaine County.

RECORDS AVAILABLE.—June, 1903, to September 30, 1917.

GAGE.—Vertical staff on right bank, 500 feet below head gates; read by Howsan Kirby.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Bed of canal is earth with no definite control. Check weirs several miles below gage may cause some backwater at high stages. Aquatic plants growing in canal during the irrigation season also cause backwater, and much silt is deposited.

ACCURACY.—Stage-discharge relation shifted during year. Rating curve well defined between 30 and 85 second-feet used April 19 to June 11 and July 10-27; curve well defined between 35 and 50 second-feet used July 28 to September 30. Gage read to hundredths twice daily. Discharge determined by applying mean daily gage height to rating table. Discharge June 12 to July 9 determined by shifting-control method because of silt in canal. Records fair.

Water is diverted from Milk River to irrigate lands on north side of river near Harlem. Water can be wasted into Milk River, but most of the water diverted is used.

Discharge measurements of Harlem canal near Zurich, Mont., during the year ending Sept. 30, 1917.

[Made by A. H. Tuttle.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
May 22	3.64	47.6	June 23	3.78	44.6	Aug. 1	a4.30	42.5
June 4	3.35	39.4	July 14	4.50	82	9	a4.08	37.8
18	3.71	45.4						

a Stage-discharge relation affected by backwater from checks below gage.

Daily discharge, in second-feet, of Harlem canal near Zurich, Mont., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	....	36	45	47	43	32	16	....	47	53	81	27	31
2	....	39	50	43	42	32	17	....	48	53	69	27	31
3	....	46	49	53	42	30	18	....	48	47	53	27	29
4	....	38	43	56	40	23	19	4.0	46	44	66	28	29
5	....	41	38	63	40	28	20	3.2	50	35	66	23	30
6	....	46	38	65	40	33	21	3.5	49	29	65	22	31
7	....	42	36	72	41	35	22	2.8	46	30	67	20	30
8	....	40	31	71	40	34	23	2.8	46	45	65	20	28
9	....	46	27	73	38	33	24	2.9	44	44	66	20	28
10	....	40	25	88	38	29	25	2.8	43	42	67	20	30
11	....	31	24	90	38	29	26	2.2	49	30	62	20	44
12	....	28	24	89	25	28	27	2.2	45	29	43	20	30
13	....	32	24	83	24	27	28	16	40	40	40	16	28
14	....	39	29	83	34	28	29	22	39	44	32	16	25
15	....	43	52	81	27	30	30	26	40	47	31	16	16
							31	....	44	....	43	22	....

Monthly discharge of Harlem canal near Zurich, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 19–30	26	2.2	7.53	179
May	50	28	42.3	2,600
June	53	24	38.2	2,270
July	90	31	63.6	3,910
August	43	16	28.9	1,780
September	44	16	29.7	1,770
The period	....	....	....	12,500

AGENCY DITCH NEAR HARLEM, MONT.

Location.—In NW. ¼ S.W. ¼ sec. 33, T. 32 N., R. 23 E., at spillway 1,000 feet below highway bridge, half a mile below head gate, and 4 miles south of Harlem, in Blaine County.

Records available.—July 14, 1905, to September 30, 1917.

Gage.—Vertical staff on right-hand downstream post of check weir at spillway; read by Estey M. Knapp.

Discharge measurements.—Made from bridge.

Channel and control.—Bed of canal is earth; backwater is caused by aquatic plants growing in the canal during irrigation season, and also by check gate 1 mile below station; that due to diversion at check gate varies with the quantity of water diverted.

Accuracy.—Stage-discharge relation affected by placing and removing checks below gage. Measurements made June 18, August 1, and August 9 give a well-defined curve beween 0 and 45 second-feet when checks below gage are in place. A parallel curve drawn through measurement made July 14 gives a rating curve for the time when checks below gage are removed. Gage read to tenths twice daily. Checks were removed June 26 and date of replacing is uncertain. Curve for period when checks were in place was used June 15–21 and July 31 to August 11. Curve for periods when checks were not in place was used June 26 to July 16. Shifting-control method used July 17–30. Records fair.

The canal takes water from Milk River for the irrigation of lands on Fort Belknap Indian Reservation. Water not required for irrigation can be wasted into White Bear Creek, 12 miles below head gate. This canal has been given a prior right by court decree to 125 second-feet of the water of Milk River and tributaries above the point of diversion.

Discharge measurements of Agency ditch near Harlem, Mont., during the year ending Sept. 30, 1917.

[Made by A. H. Tuttle.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
June 18	5.18	33.3	Aug. 1	4.40	0
July 14	4.55	26.1	9	4.49	4.8

Daily discharge, in second-feet, of Agency ditch near Harlem, Mont., for the year ending Sept. 30, 1917.

Day.	June.	July.	Aug.	Day.	June.	July.	Aug.	Day.	June.	July.	Aug.
1		26	0	11		20	5	21	8	16	
2		32	0	12		30		22	0	15	
3		32	0	13		28		23	0	14	
4		28	0	14		28		24	0	12	
5		24	0	15	44	20		25	0	11	
6		24	5	16	54	22		26	36	10	
7		24	5	17	54	22		27	32	9	
8		24	5	18	42	21		28	32	8	
9		24	5	19	25	19		29	36	7	
10		24	5	20	16	18		30	34	5	
								31		0	

Monthly discharge of Agency ditch near Harlem, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
June 15-30	54	0	25.8	819
July	32	0	18.9	1,160
Aug. 1-11	5	0	2.73	59.6
The period				2,040

NOTE.—Irrigation season ended Aug. 11.

FRENCHMAN RIVER AT INTERNATIONAL BOUNDARY.

LOCATION.—In SW. ¼ sec. 4, T. 1, R. 10 W. third meridian at Ball's ranch, in Saskatchewan, just across the international boundary from east side of lot 3, sec. 6, T. 37 N., R. 34 E. in United States.

DRAINAGE AREA.—1,875 square miles (measured by Reclamation Service, Department of Interior, Canada).

RECORDS AVAILABLE. April 1 to September 30, 1917.

GAGE.—Stevens water-stage recorder referred to staff gage in well was used after April 5. Mrs. W. B. Chamberlain read gage during year.

DISCHARGE MEASUREMENTS.—Made from cable 20 feet above gage or by wading.

CHANNEL AND CONTROL.—Bar composed of boulders and gravel forms principal control at low and medium stage. At high stages this bar is drowned out and control is below.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.99 feet at 11.30 a. m. April 30 (discharge, 2,780 second-feet); minimum flow occurred during winter, lowest measurement being March 27 (discharge, 5.2 second-feet).

ICE.—Stage-discharge relation seriously affected by ice during winter.

Diversions.—Several ditches divert water for irrigation 60 miles above station in Saskatchewan.

Regulation.—None.

Accuracy.—Stage-discharge relation fairly permanent during the year when not affected by ice. Rating curve used April 12 to September 30 well defined between 20 and 2,820 second-feet. Gage heights April 6 to September 30 from automatic record. Discharge ascertained by applying gage height to rating table. Records fair, April 1–11; good, April 12 to end of year.

Cooperation.—Station maintained in cooperation with Reclamation Service, Department of Interior, Dominion of Canada.

Discharge measurements of Frenchman River at international boundary during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 3	W. A. Lamb	2.60	59	Apr. 24	P. A. Fetterly	9.97	2,760
Mar. 26	P. A. Fetterly [a]		[b] 5.6	25	do	9.21	2,440
27	do		[b] 5.2	25	Anderson and Fetterly	9.28	2,480
30	do	3.70	[b] 45.0	30	P. A. Fetterly	9.94	2,770
31	do	3.82	[b] 37.0	May 1	do	8.62	2,240
Apr. 2	do	3.59	[b] 28.0	2	do	7.54	1,910
4	do	3.48	[b] 36.0	3	do	6.88	1,660
5	do	3.48	[b] 48.0	4	do	6.56	1,440
6	do	3.88	[b] 155	5	do	6.15	1,330
7	do	4.52	[b] 333	6	do	5.87	1,220
8	do	4.32	[b] 438	11	do	6.19	1,330
9	do	4.97	[b] 788	18	A. H. Tuttle	5.22	[b] 969
10	do	6.48	[b] 1,370	19	P. A. Fetterly	4.72	844
11	do	7.87	[b] 2,070	19	do	5.02	849
12	do	8.32	2,130	23	do	4.26	598
13	do	8.08	2,060	24	do	4.03	485
14	do	9.18	2,450	25	do	3.85	392
16	do	8.88	2,300	31	A. H. Tuttle	3.54	274
18	do	7.96	1,980	July 11	P. A. Fetterly	2.78	62
19	do	7.48	1,800	Aug. 15	do	2.30	13.8
20	do	7.06	1,640				
21	do	6.74	1,540				
23	do	8.56	2,210				

[a] Engineer, Reclamation Service, Department of the Interior, Canada.
[b] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Frenchman River at international boundary for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	30	2,210	234	55	19	18	17	2,140	1,070	147	54	17	42
2	28	1,790	234	47	18	19	18	1,990	962	181	49	17	34
3	30	1,580	234	42	18	19	19	1,810	834	178	46	18	34
4	36	1,440	234	55	18	19	20	1,620	710	150	40	19	33
5	48	1,300	214	78	18	19							
							21	1,540	656	133	36	18	33
6	155	1,200	203	91	18	18	22	1,690	648	125	34	19	33
7	333	1,240	190	87	18	18	23	2,140	571	103	32	18	29
8	438	1,280	184	81	18	18	24	2,720	478	100	31	17	28
9	788	1,320	217	76	17	18	25	2,520	410	98	29	18	29
10	1,370	1,370	210	64	16	18							
							26	2,340	356	91	28	23	25
11	2,070	1,330	190	61	16	18	27	2,330	325	87	25	24	18
12	2,080	1,360	181	59	16	19	28	2,480	310	76	24	22	19
13	2,130	1,450	165	55	16	24	29	2,700	284	64	23	19	25
14	2,440	1,500	165	47	15	27	30	2,670	281	57	21	19	22
15	2,420	1,290	162	46	16	54	31	....	252	....	20	18	....
16	2,360	1,120	147	55	16	63							

Note.—Flow Apr. 1-11 when affected by ice determined by discharge measurements and recorder records.

Monthly discharge of Frenchman River at international boundary for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April	2,720	28	1,580	94,000
May	2,210	252	998	61,400
June	234	57	158	9,400
July	91	20	48.1	2,960
August	24	15	18.0	1,110
September	63	18	26.4	1,570
The period				170,000

BEAVER CREEK NEAR MALTA, MONT.

LOCATION.—In NW. ¼ sec. 30, T. 28 N., R. 33 E., on highway at Hales crossing, at site of proposed reservoir of United States Reclamation Service, 28 miles southeast of Malta, in Phillips County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—March 31 to September 30, 1917.

GAGE.—Chain gage on downstream handrail of highway bridge; read by Charles Hales.

DISCHARGE MEASUREMENTS.—Made from highway bridge or by wading at old ford crossing, 500 feet above bridge.

CHANNEL AND CONTROL.—Channel is straight for 150 feet above and 200 feet below gage. Banks are high and practically without vegetation. Left bank is overflowed at gage height 18.5 feet. The low-water control is gravel and cobblestone bar, 400 feet below gage; probably shifting. At stages above gage height 12.5 feet the river cuts across the first oxbow below and has a decided increase of slope, materially increasing the discharge. Stage of zero flow about 0.10 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 19.5 feet April 6 (discharge, 4,990 second-feet); no flow July 1 to September 30.

ICE.—Creek freezes practically solid during winter and ice jams are frequent during the spring breakup.

DIVERSIONS.—No diversion from main stream; several on small tributaries above.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not affected by ice or shifting control. Rating curve well defined between 10 and 3,000 second-feet. Gage read to hundredths once daily. Daily discharge obtained by applying daily gage heights to rating table. Records good.

Discharge measurements of Beaver Creek near Malta, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Apr. 21	Anderson and Hill	3.40	222
May 19	Tuttle and Stratton	.88	22.1

Daily discharge, in second-feet, of Beaver Creek near Malta, Mont., for the year ending Sept. 30, 1917.

Day.	Mar.	Apr.	May.	June.	Day.	Mar.	Apr.	May.	June.
1		803	70	7.1	16		264	20.0	17.2
2		2,130	63	6.5	17		176	18.4	18.4
3		2,840	63	7.1	18		165	17.6	20.0
4		2,430	77	7.1	19		176	20.0	16.5
5		3,240	70	6.8	20		231	12.5	15.3
6		4,990	57	6.5	21		231	15.3	14.2
7		4,290	51	7.7	22		275	16.0	14.6
8		4,220	51	8.3	23		253	22	13.9
9		3,380	46	8.9	24		264	20	12.5
10		2,170	36	9.5	25		231	17.6	11.9
11		1,200	32	10.4	26		176	16.0	9.5
12		943	28	11.3	27		100	13.6	8.9
13		712	24	11.9	28		70	12.8	6.5
14		517	21	12.5	29		70	12.5	4.5
15		341	20.0	16.4	30		70	10.7	3.0
					31	429		8.9	

NOTE.—No flow after June 30.

Monthly discharge of Beaver Creek near Malta, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April	4,990	70	1,230	73,200
May	77	8.9	31.1	1,910
June	20.0	3.0	10.8	643
The period				75,800

ROCK CREEK NEAR HINSDALE, MONT.

LOCATION.—In sec. 10, T. 31 N., R. 36 E., at Ottenstror's ranch, 2 miles below head gates of Rock Creek canal and 6 miles northeast of Hinsdale, in Valley County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 19, 1912, to September 30, 1917. From July 5, 1905, to December 31, 1907, data were obtained at a station 2 miles upstream, just below the diversion dam of the Rock Creek canal. Flow at these two points is practically the same.

GAGE.—Combined overhanging chain and staff gage on left bank, back of John Ottenstror's house; chain gage reads to 16.0 feet; staff 16.0 to 24 feet. Original gage washed out during spring flood of 1917 and new one, installed 30 feet above old site, is now in use; read by Mrs. John Ottenstror and John Hoerster.

DISCHARGE MEASUREMENTS.—Made by wading a quarter of a mile below gage or from bridge 2 miles below.

CHANNEL AND CONTROL.—Water at gage is deep and sluggish at low stages. Control is a gravel bar a quarter of a mile below; shifts slightly at high water. Left bank high and is not overflowed at gage; right bank fairly high but is overflowed at flood stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 20.0 feet at 6 a. m. April 11 (discharge, 4,020 second-feet); no flow after September 13.

1906–1907 and 1912–1917: Maximum stage recorded, 18.40 feet June 9, 1906, determined by leveling from flood marks (discharge, determined from extension of rating curve, 6,220 second-feet); no flow April 14 to May 2, May 9–24, and after July 12, 1906; after September 28, 1907; April 23, 25, 27, 28, 30, May 1, 2, and 4, 1913; May 3, 5, 8, 10, and 13, 1915; and after September 13, 1917.

ICE.—Stage-discharge relation seriously affected by ice. Observations discontinued during winter.

DIVERSIONS.—There is no storage, but the normal summer flow is appropriated and used during the irrigation season.

REGULATION.—None.

ACCURACY.—Stage-discharge relation affected by ice and shifting control. Rating curve well defined between 0 and 300 second-feet used October 1 to November 25 and May 5 to June 5; curve fairly well defined between 0 and 3,400 second-feet used April 9–27 and June 28 to September 30. Gage read to tenths daily by Mrs. J. Ottenstror until July 4, and by John Hoerster after August 19; no records July 15 to August 18. Discharge determined by applying gage height to rating table; shifting-control method used April 28 to May 4, June 6–19, and June 20–27. Records fair.

Discharge measurements of Rock Creek near Hinsdale, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 28[a]	M. D. Anderson........	7.20	248	May 30	A. H. Tuttle...........	5.50	5.4
May 17	A. H. Tuttle...........	6.00	59	June 13	.....do..................	5.87	23.0

[a] Measured from bridge, 1½ miles below gage.

Daily discharge, in second-feet, of Rock Creek near Hinsdale, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	10	10	....	173	10	0	....	2
2	10	10	....	162	4	2	....	0
3	10	10	....	173	0	2	....	0
4	10	10	....	173	0	0	....	2
5	10	10	....	162	0	2	....	0
6	10	10	....	140	0	0	....	2
7	10	10	....	162	0	2	....	2
8	19	10	....	162	0	0	....	2
9	44	10	3,620	140	347	2	....	0
10	31	10	3,820	118	232	2	....	0
11	31	10	3,860	98	184	2	....	0
12	19	10	2,880	79	41	0	....	2
13	19	10	3,000	79	26	2	....	0
14	19	10	2,400	79	9	0	....	....
15	19	10	2,700	61	0	....	....	....
16	19	10	2,100	61	0	....	....	....
17	19	10	1,200	61	2	....	....	....
18	19	10	750	0	0	....	....	....
19	19	10	500	0	0	....	2	....
20	19	10	700	0	0	....	0	....
21	19	10	900	0	0	....	2	....
22	10	10	750	0	0	....	0	....
23	10	10	900	10	0	....	0	....
24	10	10	1,200	10	0	....	0	....
25	10	10	900	10	1	....	0	....
26	10	10	400	10	0	....	0	....
27	10	9	288	10	2	....	2	....
28	10	9	250	10	2	....	0	....
29	10	9	195	10	2	....	0	....
30	10	9	184	10	2	....	0	....
31	10	....	....	10	....	....	0	....

NOTE.—Observer absent Apr. 13-26, discharge estimated by comparison with Frenchman River and Porcupine Creek. No observer July 15 to Aug. 18. Discharge estimated because of ice Nov. 26-30.

Monthly discharge of Rock Creek near Hinsdale, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	44	10	15.6	959
November	10	9	9.86	587
April 9-30	3,860	184	1,520	66,300
May	173	0	70.1	4,310
June	347	0	28.8	1,710
July 1-14	2	0	1.14	31.7
August 19-31	2	0	.46	11.9
September	2	0	.40	23.8

PORCUPINE CREEK AT NASHUA, MONT.

Location.—In sec. 31, T. 28 N., R. 42 E., 500 feet above ford, a quarter of a mile mile above highway bridge, three-eights of a mile north of Nashua, in Valley County.

Drainage area.—Not measured.

Records available.—July 11, 1908, to September 30, 1917.

Gage.—Vertical staff in three sections nailed to trees on the left bank; read by Rosie Brocksmith.

Discharge measurements.—Made by wading near gage or, at high stages, from a bridge a quarter of a mile below.

Channel and control.—Bed of stream is mud. Slight gravel bar forms the control at low stages. This is soon drowned out, as the creek rises, and the control is the whole channel below gage.

Extremes of discharge.—Maximum stage recorded during year, 16.6 feet at 8 a. m. April 10 (discharge, 1,080); no flow most of the time after June 30.

1909–1917: Maximum stage recorded, 18.0 feet, April 11, 1916, determined by leveling from flood marks (discharge, determined from extension of rating curve, 2,700 second-feet); no flow during periods in 1909, 1910, 1911, 1913, 1916, and 1917.

Ice.—Stage-discharge relation seriously affected by ice. Discharge very small. Observations discontinued during winter.

Diversions.—None during 1917. A United States Reclamation Service canal is practically completed which will divert the entire flow during irrigation season.

Regulation.—None developed. A United States Reclamation Service reservoir on the middle fork of stream will partially regulate flood flow.

Accuracy.—Stage-discharge relation not permanent; affected by shifting control and seriously affected by ice. Rating curve used October 1 to November 18, well defined below 60 second-feet, and fairly well defined to 1,000 second-feet. curve used April 1 to June 1 well defined between 7 and 1,000 second-feet; June 12 to July 12 fairly well defined. Shifting-control method used June 2 to 10, Gage read to tenths twice daily during fluctuating stage and once daily at other times. Daily discharge ascertained by applying daily gage height to rating table. Records fair.

Discharge measurements of Porcupine Creek at Nashua, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	Sec.-ft.			Feet.	Sec.-ft.
Apr. 18	M. D. Anderson	8.16	260	May 29	A. H. Tutte	3.68	7.2
May 14	A. H. Tattle	4.27	28.4	June 12	.....do	3.78	6.6

Note.—Measurement Apr. 18 made from highway bridge a quarter of a mile below gage; all others by ding 100 feet above gage.

Daily discharge, in feet, of Porcupine Creek at Nashua, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Day.	Oct.	Nov.	Apr.	May.	June.	July.
1	1.6	5.5	33	82	7.9	.0	16	3.9	3.9	709	13.7	3.3	......
2	1.6	5.5	42	72	9.9	.0	17	3.9	3.9	434	13.7	3.3	......
3	1.6	5.5	42	67	7.6	.0	18	5.5	3.9	250	13.7	3.3	......
4	1.6	5.5	42	62	7.2	.0	19	5.5	......	194	13.7	3.3	......
5	2.7	5.5	102	57	6.8	.0	20	5.5	......	281	13.7	3.3	......
6	3.9	5.5	458	52	6.4	.2	21	5.5	......	345	10.8	3.3	......
7	3.9	3.9	353	47	6.0	.2	22	5.5	......	254	10.8	3.3	......
8	3.9	5.5	800	37	5.6	.0	23	5.5	......	297	7.9	3.3	......
9	3.9	3.9	989	33	5.2	.2	24	5.5	......	416	7.9	3.3	......
10	3.9	3.9	1,060	33	6.2	.2	25	5.5	......	385	7.9	2.2	......
11	3.9	3.9	935	33	6.4	.2	26	5.5	......	269	7.9	1.3	......
12	3.9	3.9	962	33	6.4	.0	27	5.5	......	173	7.9	.6	......
13	3.9	3.9	966	33	4.7	.0	28	5.5	......	126	5.5	.2	......
14	3.9	3.9	855	29	4.7	.0	29	5.5	......	102	5.5	.2	......
15	3.9	3.9	905	21	3.3	.0	30	5.5	......	92	5.5	.0	......
							31	5.5	......	......	5.5	......	......

Monthly discharge of Porcupine Creek at Nashua, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	5.5	1.6	4.29	264
November 1-18	5.5	3.9	4.52	161
April	1,060	33	429	25,500
May	82	5.5	27.2	1,670
June	9.9	.0	4.28	255
July	.2	.0	......	......
August	.0	.0	0	0
September	.0	.0	0	0

NOTE.—Creek standing in pools after June 29 except July 6-7, 9-10, when approximately 0.2 second-foot was flowing.

POPLAR RIVER BASIN.

POPLAR RIVER NEAR POPLAR, MONT.

LOCATION.—In S. ½ sec. 8, T. 28 N., R. 51 E., at United States Reclamation Service camp 5 miles north of Poplar, in Sheridan County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—October 5, 1913, to September 30, 1917, at present site; August 15, 1908, to June 30, 1911, in S. ½ sec. 5, T. 28 N., R. 51 E., at Obershaw's ranch, 6 miles north of Poplar; May 2, 1911, to October 4, 1913, at United States Reclamation camp in NE. ¼ sec. 4, T. 29 N., R. 51 E., 18 miles north of Poplar.

GAGE.—Chain gage on left bank at United States Reclamation Service camp; read by Art Pronovort and F. W. Cothren, employees of Reclamation Service.

DISCHARGE MEASUREMENTS.—Made by wading near gage or from highway bridge at Poplar, 8 miles below.

CHANNEL AND CONTROL.—Composed of gravel, clay, and boulders; shifts slightly, usually at extreme stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.95 feet at 8 a. m., April 14 (discharge, 5,280 second-feet); minimum stage recorded, 3.75 feet July 31 to August 4 (discharge, 1.5 second-feet).

1908–1917: Maximum stage recorded, 12.0 feet April 10, 1912; determined by leveling from flood marks (discharge, determined from extension of rating curve, 10,000 second-feet); minimum stage, 3.75 feet July 31 to August 4, 1917 (discharge, 1.5 second-feet).

Monthly discharge of Rock Creek near Hinsdale, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	44	10	15.6	959
November	10	9	9.86	587
April 9-30	3,860	184	1,520	66,300
May	173	0	70.1	4,310
June	347	0	28.8	1,710
July 1-14	2	0	1.14	31.7
August 19-31	2	0	.46	11.9
September	2	0	.40	23.8

PORCUPINE CREEK AT NASHUA, MONT.

LOCATION.—In sec. 31, T. 28 N., R. 42 E., 500 feet above ford, a quarter of a mile mile above highway bridge, three-eighths of a mile north of Nashua, in Valley County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—July 11, 1908, to September 30, 1917.

GAGE.—Vertical staff in three sections nailed to trees on the left bank; read by Rosie Brocksmith.

DISCHARGE MEASUREMENTS.—Made by wading near gage or, at high stages, from a bridge a quarter of a mile below.

CHANNEL AND CONTROL.—Bed of stream is mud. Slight gravel bar forms the control at low stages. This is soon drowned out, as the creek rises, and the control is the whole channel below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 16.6 feet at 8 a. m. April 10 (discharge, 1,080); no flow most of the time after June 30.

1909–1917: Maximum stage recorded, 18.0 feet, April 11, 1916, determined by leveling from flood marks (discharge, determined from extension of rating curve, 2,700 second-feet); no flow during periods in 1909, 1910, 1911, 1913, 1916, and 1917.

ICE.—Stage-discharge relation seriously affected by ice. Discharge very small. Observations discontinued during winter.

DIVERSIONS.—None during 1917. A United States Reclamation Service canal is practically completed which will divert the entire flow during irrigation season.

REGULATION.—None developed. A United States Reclamation Service reservoir on the middle fork of stream will partially regulate flood flow.

ACCURACY.—Stage-discharge relation not permanent; affected by shifting control and seriously affected by ice. Rating curve used October 1 to November 18, well defined below 60 second-feet, and fairly well defined to 1,000 second-feet. curve used April 1 to June 1 well defined be[illegible]een 7 and 1,000 second-feet; June 12 to July 12 fairly well defined. Shif[illegible] method used June 2 to 10. Gage read to tenths twice daily durin[illegible] times. Daily discharge ascertained [illegible] Records fair.

Discharge measurements of Porcu[illegible]

Date.	Made by—	[illegible]	Gage height.	Dis-ch[illegible]
Apr. 18	M. D. Anderson[illegible]	[illegible]	[illegible]	[illegible]
May 14	A. H. Tuttle..	[illegible]	[illegible]	[illegible]

NOTE.—Measureme[illegible] of a mil[illegible] wading 100 feet abov[illegible]

Daily discharge, in feet, of Porcupine Creek at Nashua, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Day.	Oct.	Nov.	Apr.	May.	June.	July.
1	1.6	5.5	33	82	7.9	.0	16	3.9	3.9	709	13.7	3.3	......
2	1.6	5.5	42	72	9.9	.0	17	3.9	3.9	434	13.7	3.3	......
3	1.6	5.5	42	67	7.6	.0	18	5.5	3.9	250	13.7	3.3	......
4	1.6	5.5	42	62	7.2	.0	19	5.5	......	194	13.7	3.3	......
5	2.7	5.5	102	57	6.8	.0	20	5.5	......	281	13.7	3.3	......
6	3.9	5.5	458	52	6.4	.2	21	5.5	......	345	10.8	3.3	......
7	3.9	3.9	353	47	6.0	.2	22	5.5	......	254	10.8	3.3	......
8	3.9	5.5	800	37	5.6	.0	23	5.5	......	297	7.9	3.3	......
9	3.9	3.9	989	33	5.2	.2	24	5.5	......	416	7.9	3.3	......
10	3.9	3.9	1,060	33	6.2	.2	25	5.5	......	385	7.9	2.2	......
11	3.9	3.9	935	33	6.4	.2	26	5.5	......	269	7.9	1.3	......
12	3.9	3.9	962	33	6.4	.0	27	5.5	......	173	7.9	.6	......
13	3.9	3.9	956	33	4.7	.0	28	5.5	......	126	5.5	.2	......
14	3.9	3.9	855	29	4.7	.0	29	5.5	......	102	5.5	.2	......
15	3.9	3.9	905	21	3.3	.0	30	5.5	......	92	5.5	.0	......
							31	5.5	......	......	5.5	......	......

Monthly discharge of Porcupine Creek at Nashua, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	5.5	1.6	4.29	264
November 1-18	5.5	3.9	4.52	161
April	1,060	33	429	25,500
May	82	5.5	27.2	1,670
June	9.9	.0	4.28	255
July	.2	.0	......	......
August	.0	.0	0	0
September	.0	.0	0	0

NOTE.—Creek standing in pools after June 29 except July 6-7, 9-10, when approximately 0.2 second-foot was flowing.

POPLAR RIVER BASIN.

POPLAR RIVER NEAR POPLAR, MONT.

LOCATION.—In S. ½ sec. 8, T. 28 N., R. 51 E., at United States Reclamation Service camp 5 miles north of Poplar, in Sheridan County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—October 5, 1913, to September 30, 1917, at present site; August 15, 1908, to June 30, 1911, in S. ½ sec. 5, T. 28 N., R. 51 E., at Obershaw's ranch, 6 miles north of Poplar; May 2, 1911, to October 4, 1913, at United States Reclamation camp in NE. ¼ sec. 4, T. 29 N., R. 51 E., 18 miles north of Poplar.

GAGE.—Chain gage on left bank at United States Reclamation Service camp; read by Art Pronovort [illegible] Cothren, employees of Reclamation Service.

DISCHARGE MEASURE[illegible] by wading near gage or from highway bridge at P[illegible] 8 mil[illegible]

[illegible] CON[illegible] gravel, clay, and boulders; shifts slightly.

[illegible] recorded during year [illegible]

[illegible] -feet); minimum stage recorded [illegible]

[illegible] cond-feet).

[illegible] 2.0 feet April [illegible] determined by

[illegible] ermined from [illegible]

[illegible] feet July [illegible]

ICE.—Stage-discharge relation seriously affected by ice November 29 to December 5; April 3–9. Discharge estimated November 29–30 at 47 and 43 second-feet, respectively. No records December 6 to April 2.

DIVERSIONS.—Poplar River canals, East and West, diverted water above gage for irrigation of approximately 10,000 acres. When the system of reservoirs is completed about 28,000 acres can be irrigated. Low flow during July, August, and September owing to the fact that all the water was diverted above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent, affected by shifting control and by ice. Daily gage heights are the mean of two readings daily during high water, and one reading daily at other times. Daily discharge October 1 to May 14 obtained from rating curve well defined below 1,800 second-feet; June 11 to September 30 from a rating curve well defined between 5 and 120 second-feet; May 15 to June 10 by shifting-control method. Low flow July 14 to September 18 represents return water and seepage only, as all the water is diverted above. Water was turned into the river on September 18.

Discharge measurements of Poplar River near Poplar, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 17[a]	M. D. Anderson	8.34	2,410	June 11	A. H. Tuttle	4.88	114
May 13	A. H. Tuttle	5.20	244	Aug. 5	.....do	3.92	3.2
28	.....do	4.78	108				

[a] Made from highway bridge at Poplar, 8 miles below gage. All others by wading near gage.

Daily discharge, in second-feet, of Poplar River near Poplar, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	36	43		550	75	42	1.5	2.5
2	36	43		484	75	38	1.5	2.5
3	47	43		441	98	35	1.5	2.5
4	50	43		420	92	32	1.5	2.5
5	50	43		380	92	30	2.0	2.5
6	57	43		361	77	30	2.0	2.5
7	57	43		342	72	28	2.0	2.5
8	57	43		324	72	26	2.5	2.5
9	57	43		324	70	21	2.5	2.5
10	50	43	2,550	324	102	18	2.5	2.5
11	50	62	3,090	306	116	14	2.5	2.5
12	50	50	4,100	272	166	30	2.5	2.5
13	50	62	4,960	239	166	26	2.5	2.5
14	50	53	5,220	239	147	8	2.5	4.0
15	50	50	4,460	229	138	8	2.5	4.0
16	50	50	3,530	217	131	7	2.5	5.5
17	50	50	2,550	207	124	5.5	2.5	5.5
18	50	50	1,440	184	116	5.5	2.5	8.0
19	50	43	1,130	181	110	5.5	2.5	8.0
20	47	43	990	155	96	5.5	2.5	11
21	43	47	925	152	86	4.0	2.5	14
22	50	50	695	152	91	3.0	2.5	14
23	50	50	865	150	91	2.5	2.5	14
24	50	50	1,130	150	79	2.5	2.5	14
25	50	50	990	136	63	2.5	2.5	18
26	50	50	1,200	125	59	2.5	2.5	18
27	50	50	865	116	59	2.5	2.5	18
28	47	50	750	108	52	2.5	2.5	13
29	43	47	695	94	46	2.5	2.5	11
30	43	43	645	88	46	2.0	2.5	11
31	43			83		1.5	2.5	

Monthly discharge of Poplar River near Poplar, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	57	36	48.8	3,000
November	62	43	47.7	2,840
April 10-30	5,220	645	2,040	85,000
May	550	83	243	14,900
June	166	46	93.6	5,570
July	42	1.5	14.3	879
August	2.5	1.5	2.32	143
September	18	2.5	7.45	443

BIG MUDDY CREEK BASIN.

BIG MUDDY CREEK NEAR CULBERTSON, MONT.

LOCATION.—In NE. ¼ sec. 20, T. 29 N., R. 54 E., at Kraft's (formerly Sholtz's) ranch, 11 miles above mouth of stream, 15 miles northwest of Culbertson, in Sheridan County, and 8 miles above site of original station at Boyd's ranch, which was discontinued.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—July 19, 1909, to September 30, 1917, at present station; July 14, 1908, to July 19, 1909, at original station.

GAGE.—An inclined staff on left bank near the house on Kraft's ranch. Since August 19, 1916, read by Jacob Kraft. This gage has been read since July 19, 1909. Previous to that date a staff gage at Boyd's ranch, 8 miles downstream, was read.

DISCHARGE MEASUREMENTS.—Made by wading or from bridge about 9 miles below gage.

CHANNEL AND CONTROL.—A bar of gravel with a few small boulders forms the extreme low-water control; but this is soon drowned out, as the creek rises, and the control is the whole bed of the stream below. The creek has a very small slope, crooked channel, and mud banks which are fairly high and are seldom overflowed. Weeds grow thick in the channel above the control during summer, and cause backwater at gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.10 feet April 16, 17, 18 (discharge, 1,460 second-feet); minimum stage recorded during year, 1.70 feet August 22, 23, and September 13 (discharge, 0.5 second-foot).

1909–1917: Maximum stage recorded, 11.4 feet March 31, 1916 (discharge, 1,550 second-feet); minimum stage, 1.5 feet September 16–18, 1915 (discharge, 0).

ICE.—Little, if any, flow during winter.

DIVERSIONS.—Several small pumping plants divert water for irrigation above station; amount unknown.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; seriously affected by ice and by occasional shifts in control. Rating curve used October 1 to November 11, fairly well defined below 30 second-feet; curve used March 30 to September 30, well defined. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records fair, October and November; good, April to September.

Discharge measurements of Big Muddy Creek near Culbertson, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 16	M. D. Anderson	11.10	1,450	June 9	A. H. Tuttle	3.55	79
May 12	A. H. Tuttle	5.32	256	Aug. 4	.....do	1.92	2.3
27	.....do	4.34	152				

NOTE.—Measurements Apr. 16 and May 12 made from highway bridge 9 miles below gage; all others by wading at ford 300 feet below gage.

Daily discharge, in second-feet, of Big Muddy Creek near Culbertson, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	5.5	6.2		206	572	90	34	4.0	0.8
2	6.2	7.0		188	494	86	26	4.0	1.0
3	7.0	5.5		194	449	106	24	2.0	1.0
4	7.0	5.5		200	389	102	26	2.0	.8
5	8.0	7.0		406	372	94	32	2.0	.8
6	9.0	6.2		729	356	90	34	2.0	.8
7	8.0	7.0		795	406	82	34	1.5	.8
8	7.0	8.0		960	332	78	36	1.5	.8
9	7.0	8.0		927	280	78	34	1.5	1.0
10	8.0	9.0		1,150	274	90	34	1.0	1.0
11	8.0	9.0		1,430	267	86	30	1.5	1.0
12	8.0			1,430	254	82	30	1.5	.8
13	9.0			1,430	254	72	26	1.5	.5
14	9.0			1,430	242	50	24	2.0	.8
15	7.0			1,430	218	50	18	2.0	1.0
16	8.0			1,460	294	56	18	1.0	2.0
17	8.0			1,460	240	65	18	1.0	1.5
18	9.0			1,460	133	62	18	1.0	2.0
19	9.0			1,410	162	59	16	.8	1.5
20	10.0			1,390	194	56	16	.8	2.0
21	9.0			1,190	178	62	14	.8	3.0
22	8.0			1,190	162	62	14	.5	3.0
23	7.0			1,050	152	56	14	.5	4.0
24	7.0			1,030	115	53	12	.8	4.0
25	6.2			971	133	53	10	.8	5.5
26	5.5			806	147	50	12	.8	5.5
27	5.5			828	138	50	10	.8	5.5
28	5.5			784	115	53	7	.8	7.0
29	7.0			718	106	47	7	.8	7.0
30	9.0		152	652	102	44	5.5	.8	7.0
31	7.0		221		98		5.5	.8	

Monthly discharge of Big Muddy Creek near Culbertson, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	10	5.5	7.56	465
November 1-11	9.0	5.5	7.13	156
April	1,460	188	977	58,100
May	572	98	246	15,100
June	106	44	68.8	4,090
July	36	5.5	20.6	1,270
August	4.0	.5	1.38	85
September	7.0	.5	2.45	146

YELLOWSTONE RIVER BASIN.

YELLOWSTONE RIVER NEAR CANYON HOTEL, YELLOWSTONE NATIONAL PARK.

Location.—Approximately in sec. 16, T. 13 S., R. 10 E. Montana meridian, half a mile upstream from Upper Falls and Canyon soldier station, 1½ miles south of Canyon Hotel, and 13 miles below outlet of Lake Yellowstone.

Drainage area.—1,280 square miles (measured on topographic maps).

Records available.—June 23, 1913, to September 30, 1917.

Gage.—Friez water-stage recorder on left bank, 450 feet above Chittenden Bridge, and 900 feet below former vertical staff installed October 11, 1916, at about same datum. Vertical staff used September 13, 1913, to October 11, 1916. Original gage used June 22 to September 12, 1913, was of same type and at same site but set to datum 1.03 feet higher than later staff. Readings on original gage reduced to datum of later staff. Gage read by privates and noncommissioned officers attached to Canyon soldier station.

Discharge measurements.—Made by wading at low stages at a gravel and boulder section 100 feet below former staff gage. High-stage measurements made from cable one-fifth of a mile above new gage.

Channel and control.—One channel at all stages. Bed of stream composed of gravel and boulders; control formed by upper portion of the Upper Yellowstone Falls and is practically permanent.

Ice.—Stage-discharge relation affected by ice; gage reading discontinued during winter.

Extremes of discharge.—Maximum stage recorded during year, 4.08 feet at 4.30 p. m. July 11 (discharge, 7,220 second-feet); minimum stage recorded, 1.00 foot at 11 a. m. May 12 (discharge, 875 second-feet). A less gage height and discharge occurred during period of no record.

1913–1917: Maximum stage recorded, 4.08 feet at 4.30 p. m., July 11, 1917 (discharge, 7,220 second-feet); minimum stage recorded, 0.75 foot October 16, 1915 (discharge, 675 second-feet). A less gage height and discharge occurred during periods of no records.

Diversions.—None above station.

Regulation.—None.

Accuracy.—Stage-discharge relation practically permanent. Gage read once daily to half-tenths prior to May 26, except during winter. Rating curve is well defined. Daily discharge ascertained by applying daily gage height to rating table prior to May 26. After that date, daily discharge ascertained by applying mean daily height obtained by inspection of recorder graph to rating table. Records good.

Discharge measurements of Yellowstone River near Canyon Hotel, Yellowstone National Park, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 9	C. G. Paulsen	1.34	1,200	June 27	G. C. Baldwin	3.57	5,690
11	.....do	1.31	1,180	Sept. 3	.....do	2.02	2,140
June 26	G. C. Baldwin	3.51	5,560				

Daily discharge, in second-feet, of Yellowstone River near Canyon Hotel, Yellowstone National Park, for the year ending Sept. 30, 1917.

Day.	Oct.	May.	June.	July.	Aug.	Sept.	Day.	Oct.	May.	June.	July.	Aug.	Sept.
1			1,820	6,380	4,980	2,270	16	1,120	1,050	2,630	6,980	3,240	1,780
2			1,820	6,530	4,850	2,270	17	1,110	1,090	2,940	6,820	3,140	1,750
3			1,800	6,530	4,720	2,190	18		1,140	3,250	6,820	3,140	1,730
4			1,780	6,680	4,720	2,100	19		1,180	3,550	6,680	3,030	1,700
5			1,750	6,680	4,570	2,070	20		1,240	3,860	6,680	2,930	1,680
6			1,820	6,820	4,430	2,060	21		1,290	4,160	6,530	2,930	1,650
7			1,900	6,820	4,280	2,020	22		1,350	4,470	6,380	2,820	1,630
8			2,060	7,130	4,140	1,980	23		1,400	4,770	6,380	2,730	1,600
9			2,270	7,130	3,990	1,920	24		1,460	5,080	6,240	2,630	1,590
10	1,180		2,360	7,130	3,840	1,870	25		1,530	5,390	6,090	2,630	1,560
11	1,180		1,980	7,130	3,700	1,840	26		1,590	5,520	5,950	2,540	1,520
12	1,180	875	2,270	7,130	3,700	1,800	27		1,610	5,800	5,800	2,540	1,490
13	1,170	918	2,270	7,130	3,590	1,770	28		1,750	5,950	5,660	2,440	1,470
14	1,140	962	2,440	7,130	3,470	1,800	29		1,800	6,090	5,520	2,440	1,420
15	1,130	1,000	2,540	7,130	3,360	1,800	30		1,800	6,240	5,390	2,360	1,430
							31		1,810		5,250	2,270	

NOTE.—Discharge interpolated May 13-18, 20-25, May 30-June 1, June 17-24, Aug. 5-10, and Sept. 16-21.

Monthly discharge of Yellowstone River near Canyon Hotel, Yellowstone National Park, for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October 10-17	1,180	1,110	1,150	18,200
May 12-31	1,810	875	1,340	53,200
June	6,240	1,750	3,350	199,000
July	7,130	5,250	6,540	402,000
August	4,980	2,270	3,420	210,000
September	2,270	1,420	1,790	107,000

YELLOWSTONE RIVER AT CORWIN SPRINGS, MONT.

LOCATION.—In NE. ¼ sec. 30, T. 8 S., R. 8 E., at highway bridge in canyon at Corwin Springs, in Park County, 8 miles below Gardiner, northern entrance to Yellowstone National Park.

DRAINAGE AREA.—2,630 square miles.

RECORDS AVAILABLE.—September 2, 1910, to September 30, 1917.

GAGE.—Chain gage fastened to floor of highway bridge on downstream side near right bank. Before October 25, 1911, staff gage set to same datum and fastened to pile beside concrete abutment on right bank. Gage read by Mrs. C. H. Wilks and Mrs. Lena Bassett.

DISCHARGE MEASUREMENTS.—Made from downstream side of highway bridge.

CHANNEL AND CONTROL.—Bed of stream composed of small rocks. Current swift at all stages; no definite control visible but has not shifted since station was established. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.6 feet June 25 (discharge, 20,200 second-feet); minimum stage recorded, 0.7 foot February 9 (discharge, 870 second-feet).

1910–1917: Maximum stage recorded, 10.2 feet June 13, 1911 (discharge, 22,800 second-feet); minimum stage recorded, 0.6 foot January 1, 1916 (discharge, 830 second-feet).

ICE.—On account of missing gage readings and severe ice conditions for short period, the flow for the months of December and January was not computed; February 18 and 19 was estimated on account of anchor ice at 970 second-feet.

DIVERSIONS.—No water diverted from the Yellowstone above station.

REGULATION.—Yellowstone Lake furnishes a natural but uncontrolled regulation.

ACCURACY.—Stage-discharge relation permanent since station was established, except during ice-affected periods. Rating curve well defined between 1,000 and 18,300 second-feet. Gage read to half-tenths once daily. Gage not read on October 17, December 10–14, December 27 to January 5, January 18–24. Daily discharge ascertained by applying gage height to rating table, except October 17, when discharge was interpolated, and February 18–19, when discharge was estimated on account of ice. Records for open channel are good. There may have been slight ice effect during November and February, and records for these months may be slightly high.

No discharge measurements were made at this station during the year.

Daily discharge, in second-feet, of Yellowstone River at Corwin Springs, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,180	1,500	1,070	935	1,220	1,400	5,700	16,400	6,970	3,190
2	2,230	1,450	1,010	960	1,220	1,450	6,490	16,400	6,730	3,060
3	2,230	1,600	1,040	960	1,220	1,400	6,020	16,400	6,490	3,060
4	2,010	1,600	960	1,010	1,220	1,400	5,590	16,600	6,490	3,060
5	2,010	1,600	985	1,010	1,240	1,400	5,280	17,700	6,490	3,330
6	2,010	1,550	960	1,010	1,310	1,450	5,180	17,400	6,250	3,190
7	2,060	1,500	935	1,010	1,240	1,600	5,590	16,900	5,800	3,470
8	2,060	1,400	910	1,010	1,360	1,650	6,020	17,100	5,380	3,060
9	2,010	1,500	870	1,010	1,360	1,750	8,900	16,800	5,380	3,060
10	2,010	1,400	890	1,010	1,400	1,960	8,360	15,800	5,280	3,060
11	2,010	1,360	910	1,040	1,450	2,280	8,230	14,900	5,180	2,930
12	1,900	1,140	890	1,070	1,500	2,680	7,970	14,400	4,980	2,860
13	1,850	1,070	910	1,070	1,500	3,120	7,270	13,000	4,980	2,680
14	1,800	1,260	960	1,070	1,400	3,980	8,490	12,800	4,790	2,800
15	1,850	1,500	985	1,070	1,360	5,380	10,700	12,200	4,600	3,060
16	1,900	1,700	985	1,080	1,310	7,220	14,300	11,600	4,600	3,060
17	1,820	1,500	985	1,080	1,360	5,180	17,700	11,000	4,600	2,930
18	1,750	1,400	970	1,080	1,310	4,980	19,900	11,000	4,240	2,800
19	1,700	1,310	970	1,100	1,310	5,180	18,600	11,000	4,240	2,680
20	1,600	1,260	960	1,160	1,310	5,910	18,300	10,700	4,240	2,680
21	1,650	1,220	985	1,180	1,310	5,800	18,300	10,200	3,900	2,560
22	1,700	1,180	985	1,100	1,400	5,590	19,900	9,870	3,900	2,500
23	1,650	1,260	960	1,140	1,500	6,250	18,500	9,870	3,900	2,500
24	1,700	1,220	985	1,140	1,550	7,220	18,900	9,590	3,900	2,680
25	1,700	1,180	1,000	1,140	1,650	6,610	20,200	9,590	3,750	2,560
26	1,700	1,220	985	1,140	1,600	6,970	18,500	8,760	3,470	2,560
27	1,750	1,260	985	1,100	1,600	6,490	17,500	8,490	3,400	2,450
28	1,700	1,310	985	1,140	1,400	7,220	18,000	8,230	3,400	2,560
29	1,700	1,260		1,260	1,400	8,230	18,900	7,600	3,400	2,500
30	1,700	1,260		1,360	1,400	7,720	19,300	7,220	3,330	2,500
31	1,650			1,260		6,250		7,220	3,330	

Monthly discharge of Yellowstone River at Corwin Springs, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	2,230	1,600	1,860	114,000
November	1,700	1,070	1,370	81,500
February	1,070	870	965	53,600
March	1,360	935	1,090	67,000
April	1,650	1,220	1,380	82,100
May	8,230	1,400	4,380	269,000
June	20,200	5,180	12,800	762,000
July	17,700	7,220	12,500	769,000
August	6,970	3,330	4,750	292,000
September	3,470	2,450	2,850	170,000

YELLOWSTONE RIVER AT INTAKE, MONT.

LOCATION.—In NW. ¼ sec. 36, T. 18 N., R. 56 E., at Lower Yellowstone diversion dam at Intake, in Dawson County, 18 miles below Glendive.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—January 1, 1911, to September 30, 1917. At Glendive, 18 miles above, by War Department and Department of Agriculture 1893 to 1903, and by Geological Survey, August 1, 1903, to December 31, 1910.

GAGE.—Chain gage on north abutment of dam showing depth of water on crest; read by Howard Roby and Matt Griebler, employees of United States Reclamation Service.

DISCHARGE MEASUREMENTS.—Made from bridge at Glendive.

Channel and control.—Dam forming the principal control is a rock filled timber crib structure on pile foundation, completed January 29, 1910; 700 feet long; crosses the stream at right angles to current, and raises low-water level about 4 feet; specially designed to resist the destructive effects of ice by approach on a slope of 3 to 1; downstream face is ogee-shaped and protected by a heavy rock apron.

Extremes of discharge.—Maximum stage recorded during year, 15 and 16 feet at 8 a. m. April 3 (stage-discharge relation affected by ice jam 2½ miles below; discharge not computed); minimum stage recorded, 1.2 feet November 15 (discharge, 4,040 second-feet). A lower stage may have occurred during frozen period.

1903–1917: Maximum stage, open channel recorded, 10.1 feet July 4, 1912 (discharge, 112,000 second-feet); minimum stage recorded, 0.9 foot December 26–28 (discharge, 2,950 second-feet).

Ice—Stage-discharge relation seriously affected by ice January 1 to April 3; flow not computed.

Diversions.—The Lower Yellowstone canal, which divers water to irrigate 66,000 acres of land, heads at north abutment of dam. There are also many diversions on the tributaries above station.

Regulation.—Yellowstone Lake and Shoshone reservoir form the only important regulation above, and control only a small part of the flood flow.

Accuracy.—Stage-discharge relation permanent, except as affected by ice. Rating curve fairly well defined by discharge measurements made at Glendive and curve of relation between gage heights at Glendive and at Lower Yellowstone dam. Gage read to tenths twice daily, except for period January 6 to March 23 when they are estimated from hole cut in ice near gage. Daily discharge ascertained by applying mean daily gage height to rating table. Records fair.

No discharge measurements made during year.

Daily discharge, in second-feet, of Yellowstone River at Intake, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	6,240	7,800	7,260	....	13,600	56,800	86,400	25,400	9,540
2	6,240	7,800	6,740	....	13,600	53,800	84,800	23,400	9,540
3	6,740	7,800	6,740	....	14,400	56,800	86,400	21,400	9,540
4	6,740	7,800	7,800	50,800	14,400	47,900	81,600	19,500	9,540
5	6,740	7,260	6,740	36,800	14,400	42,200	72,200	17,700	9,540
6	6,740	7,260	6,740	36,800	14,400	47,900	69,100	17,700	9,540
7	6,740	7,260	5,760	35,600	15,200	42,200	70,600	16,000	9,540
8	6,740	6,740	6,240	39,400	15,200	36,800	72,200	16,000	9,540
9	6,740	6,740	6,740	33,100	16,000	32,000	72,200	14,400	9,540
10	6,740	6,740	7,260	32,000	16,000	30,800	73,800	14,400	9,540
11	7,260	6,740	6,740	29,600	16,000	34,300	75,300	13,600	9,540
12	7,260	6,740	6,240	25,400	16,800	39,400	75,300	13,600	9,540
13	7,800	4,860	6,240	21,400	16,800	55,200	72,200	12,900	9,540
14	7,800	4,440	5,760	19,500	16,000	59,800	69,100	12,900	10,200
15	7,800	4,040	5,760	18,600	16,800	50,800	62,900	12,200	10,200
16	7,260	4,440	5,760	17,700	17,700	45,000	55,200	11,500	10,200
17	7,260	4,860	4,860	16,800	21,400	42,200	50,800	11,500	10,200
18	7,800	4,860	4,860	16,000	27,500	42,200	45,000	10,800	10,800
19	7,800	4,860	5,300	14,400	35,600	55,200	42,200	10,200	11,500
20	7,800	5,300	4,860	14,400	34,300	70,600	39,400	10,200	11,500
21	7,800	6,740	4,860	13,600	34,300	81,600	38,100	10,200	11,500
22	7,800	8,940	4,860	12,900	33,100	91,400	36,800	10,200	11,500
23	7,800	8,940	4,860	11,500	39,400	94,600	34,300	10,200	11,500
24	7,800	8,940	4,860	10,800	42,200	91,400	33,100	10,200	11,500
25	8,360	8,360	4,440	11,500	40,800	94,600	32,000	10,200	10,200
26	8,360	8,360	4,440	11,500	38,100	94,600	32,000	10,200	9,540
27	8,360	8,360	4,440	12,200	42,200	91,400	30,800	10,200	9,540
28	8,360	7,800	5,300	12,900	42,200	91,400	29,600	9,540	8,940
29	8,360	7,800	5,300	12,900	45,000	94,600	29,600	9,540	8,940
30	8,360	7,800	5,300	12,900	45,000	89,700	27,500	9,540	8,940
31	8,360	....	5,300	....	47,900	....	27,500	9,540	....

Monthly discharge of Yellowstone River at Intake, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	8,360	6,240	7,480	460,000
November	8,940	4,040	6,880	409,000
December	7,800	4,440	5,750	354,000
Apr. 3-30	50,800	10,800	21,500	1,151,000
May	47,900	13,600	26,300	1,620,000
June	94,600	30,800	61,900	3,680,000
July	86,400	27,500	55,100	3,390,000
August	25,400	9,540	13,400	824,000
September	11,500	8,940	10,000	595,000

BIG TIMBER CREEK NEAR BIG TIMBER, MONT.

Location.—In SE. ¼ sec. 5, T. 2 N., R, 14 E., at Webb's ranch, 4 miles below junction of forks of Big Timber Creek and 9 miles northwest of Big Timber, in Sweetgrass County.

Drainage area.—Not measured.

Records available.—April 13, 1912, to September 30, 1917.

Gage.—Chain gage on left bank below lower barns, and about one-eighth of a mile below house at Webb's ranch; read by L. E. Webb to May 21. This was destroyed by high water and on August 8, 1917, a temporary overhanging chain gage was set on left bank opposite sheep sheds and 500 feet above site of old gage. Read by John Kremper.

Discharge measurements.—Made by wading.

Channel and control.—Bed and banks are of gravel and boulders and are subject to change at each high stage.

Extremes of discharge.—Maximum stage recorded during year, 4.10 feet May 12 (discharge, 212 second-feet); minimum stage, 3.25 feet October 5-7 and November 12 (discharge, 18 second-feet).

1912-1917: Maximum stage recorded, 4.8 feet June 5, 1914 (discharge, 937 second-feet); minimum stage, 2.65 feet March 20, 1915 (discharge, 7 second-feet).

Ice.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

Diversions.—Numerous irrigating ditches divert water both above and below the gage.

Regulation.—None.

Accuracy.—Stage-discharge relation entirely changed by high water of June, requiring a new gage location; stage-discharge relation unchanged at new site during period of record. Rating curves fairly well defined. Gage read to half-tenths daily to May 21 and twice daily August 8 to September 30. Daily discharge ascertained by applying mean daily gage height to rating tables except for October 1, interpolated. Records fair.

Discharge measurements of Big Timber Creek near Big Timber, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Oct 2	C. S. Heidel	3.35	27.7
Aug. 8	W. A. Lamb	2.45	80

Daily discharge, in second-feet, of Big Timber Creek near Big Timber, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	Aug.	Sept.	Day.	Oct.	Nov.	Apr.	May.	Aug.	Sept.
1	26	23		68		37	16	35				67	40
2	29	29		78		34	17	35				80	34
3	29	29		100		28	18	35				70	40
4	23	29		88		31	19	29				74	34
5	18	29		88		40	20	29			50	74	34
6	18	23		100		34	21	29			78	62	40
7	18	23		112		31	22	29		50		62	34
8	29	23		112	80	34	23	29		78		44	34
9	23	23		140	80	37	24	23		88		40	42
10	23	23		173	80	34	25	23		112		44	40
11	29	23		192	74	28	26	29		88		44	37
12	29	18		212	74	31	27	29		78		40	40
13	29				80	34	28	29		68		44	40
14	35				74	67	29	29		68		40	37
15	35				87	57	30	29		68		44	34
							31	23				44	

Monthly discharge of Big Timber Creek near Big Timber, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	35	18	27.6	1,700
November 1-12	29	18	24.6	586
April 22-30	112	50	77.6	1,380
August 8-31	87	40	62.6	2,960
September	67	28	37.2	2,210

SWEETGRASS CREEK ABOVE MELVILLE, MONT.

Location.—About in middle of sec. 27, T. 5 N., R. 13 E., on T. S. Lavold's ranch, 9 miles northwest of Melville, in Sweet Grass County.

Drainage area.—About 63 square miles (measured on topographic map).

Records available.—August 21, 1913, to September 30, 1917; May 5, 1907, to December 31, 1912, for station at C. M. Reins's ranch in SW. ¼ sec. 24, T. 5 N., R. 12 E., 17 miles northwest of Melville. No diversions or tributaries between two stations.

Gage.—Vertical staff on left bank three-fourths of a mile above T. S. Lavold's house; read by T. S. Lavold.

Discharge measurements.—Made by wading 100 feet above gage or from bridge near observer's house.

Channel and control.—Stream bed of gravel and boulders; slightly shifting. Banks high; not subject to overflow.

Extremes of discharge.—Maximum stage during year, 3.2 feet June 10 (discharge, 1,260 second-feet) ;minimum stage, 0.5 foot November 13–14 (discharge, 13 second-feet).

1907–1912: Maximum stage recorded at old section, 5.15 feet June 1, 1908 (discharge, 1,490 second-feet); minimum stage, 1.42 feet April 18–19, 1911, and April 23–30, 1912 (discharge, 8.6 second-feet).

1913–1917: Maximum stage recorded at present site, 2.7 feet June 4, 1914 (discharge, 1,280 second-feet); minimum stage, 0.45 foot April 29, 1915 (discharge, 11 second-feet).

Ice.—Stage-discharge relation seriously affected by ice. Observations discontinued during winter.

DIVERSIONS.—Two small ditches divert water above gage; quantity diverted is negligible.

REGULATION.—None.

ACCURACY.—Stage-discharge relation fairly permanent. Rating curve well defined below 700 second-feet. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good.

Discharge measurements of Sweetgrass Creek above Melville, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Oct. 2	C. S. Heidel	0.78	32.4
Aug. 7	W. A. Lamb	1.35	128

Daily discharge, in second-feet, of Sweetgrass Creek above Melville, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	May.	June.	July.	Aug.	Sept.
1	37	27	19	19	247	578	178	80
2	37	27	19	27	210	578	178	80
3	37	27	19	19	210	450	149	80
4	37	27	19	19	210	450	149	80
5	37	27	19	19	290	511	149	80
6	37	27	19	27	247	511	178	80
7	37	23	19	27	210	450	136	80
8	32	23	19	27	210	511	136	80
9	32	23	19	27	650	578	136	63
10	32	23	....	37	1,260	578	123	63
11	32	23	....	37	797	511	123	63
12	32	19	....	37	450	450	123	56
13	32	13	....	80	340	393	112	56
14	32	13	....	80	247	340	100	56
15	32	19	....	80	290	290	100	56
16	32	19	....	63	723	290	100	72
17	32	27	....	100	872	290	100	72
18	37	27	....	123	650	290	100	72
19	37	19	....	210	723	247	100	63
20	37	19	....	450	723	247	90	63
21	37	19	....	290	650	247	80	63
22	32	23	....	247	797	247	72	63
23	32	23	....	210	650	247	72	63
24	32	23	....	210	650	247	72	63
25	32	23	....	340	650	247	72	63
26	32	19	....	450	797	247	72	63
27	27	19	....	290	723	210	72	63
28	27	19	....	290	650	210	72	63
29	27	19	....	340	650	210	72	80
30	27	19	....	290	578	210	72	80
31	27	....	....	247	....	210	72	....

Monthly discharge of Sweetgrass Creek above Melville, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	37	27	33.0	2,030
November	27	13	21.9	1,300
December 1-9	19	19	19.0	339
May	450	19	152.	9,350
June	1,260	210	545.	32,400
July	578	210	357.	22,000
August	178	72	108.	6,640
September	80	56	68.6	4,080

SWEETGRASS CREEK BELOW MELVILLE, MONT.

Location.—Near middle of south line of sec. 27, T. 4 N., R. 15 E., at Crum's ranch, a quarter of a mile above head of intake canal of Big Timber Carey project and 6 miles southeast of Melville, Sweet Grass County.

Drainage area.—137 square miles (measured on topographic maps).

Records available.—April 1, 1909, to November 10, 1916; and August 8 to September 30, 1917. May 4, 1907, to April 1, 1909, at Adam's ranch 2½ miles downstream.

Gage.—Overhanging chain gage on left bank 100 feet west of Crum's house; read by Swen Johnson October 1 to November 10; and by Chas. E. Crum August 8 to September 30.

Discharge measurements.—Made by wading or from highway bridge half a mile above gage.

Channel and control.—Stream bed of clean gravel; bar producing riffle 300 feet around a bend below gage, likely to shift. Right bank low; subject to overflow during high stages; left bank is a cut bank at the gage and not overflowed at that point, but is lower and may be subject to overflow about 200 feet below gage.

Extremes of discharge.—Maximum stage recorded during year 1.97 feet at 7.30 a. m. August 9 (discharge, 95 second-feet); minimum stage 1.2 feet October 1, 2, 13, and 14 (discharge 38 second-feet).

1909–1917: Maximum stage recorded, 4.2 feet during June high water, as estimated on June 27, 1916, from high-water marks (discharge, from extension of rating table, 1,700 second-feet); minimum stage recorded, 1 foot August 23–25, September 2–4 and 6, 1913 (discharge, 10 second-feet).

Ice.—Stage-discharge relation seriously affected by ice; no record for ice period.

Diversions.—There are adjudicated rights from Sweetgrass Creek amounting to over 500 second-feet, and numerous ditches divert water both above and below station. The intake canal of the Big Timber Carey project, which will carry 600 second-feet, diverts into two connecting storage reservoirs, one of 6,000, and the other 12,000 acre-feet capacity.

Regulation.—None.

Accuracy.—Stage-discharge relation changed during period of no records from November 11 to August 7; both rating curves used are fairly well defined. Gage read to half-tenths once daily October 1 to November 10, 1916; and to hundredths twice daily after August 7, 1917. Daily discharge ascertained by applying mean daily gage height to rating table. Records fair.

Discharge measurements of Sweetwater Creek below Melville, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Oct. 2	C. S. Heidel	1.23	41.4
Aug. 8	W. A. Lamb	1.91	93

Daily discharge, in second-feet, of Sweetgrass Creek below Melville, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Aug.	Sept.	Day.	Oct.	Nov.	Aug.	Sept.
1	38	48		62	16	43		67	67
2	38	48		62	17	48		65	62
3	43	43		59	18	48		65	62
4	48	43		62	19	54		69	62
5	48	43		62	20	48		68	57
6	54	48		62	21	43		64	57
7	48	48		62	22	48		62	57
8	48	43	85	62	23	43		63	59
9	54	48	90	59	24	48		54	77
10	48	48	86	59	25	48		50	67
11	43		83	56	26	48		53	64
12	43		77	53	27	48		55	64
13	38		76	53	28	43		55	62
14	38		72	73	29	48		53	63
15	43		67	80	30	48		55	69
					31	48		62	

Monthly discharge of Sweetgrass Creek below Melville, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	54	38	46.0	2,830
November 1-10	48	43	46.0	912
August 8-31	90	50	66.5	3,170
September	80	53	62.5	3,720

PRYOR CREEK AT COBURN, MONT.

Location.—In SE. ¼ sec. 35, T. 1 S., R. 27 E., on Crow Indian Reservation at Coburn, in Yellowstone County, 12 miles southwest of Billings and 13 miles above mouth of creek.

Drainage area.—Not measured.

Records available.—September 13, 1911, to September 30, 1917.

Gage.—Overhanging chain gage on left bank, opposite observer's house; read by Harry Foster.

Discharge measurements.—Made by wading.

Channel and control.—Bed of stream gravel and clay. Principal control is gravel bar which forms a riffle at low stages about 300 feet below gage; at a medium stage the riffle disappears and no well defined control exists. Both banks high and not subject to overflow except at extreme stages. Current at gage is sluggish at low stages but of medium velocity at high stages.

Extremes of discharge.—Maximum stage recorded during year, 10.44 feet at 7 p. m. June 5 (discharge, 750 second-feet); minimum stage recorded, 4.1 feet August 25 and 30, September 4 (discharge, 20 second-feet).

1911–1917: Maximum stage recorded, that of June 5, 1917; minimum stage, 3.6 feet September 1, 1913 (discharge, 6 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

DIVERSIONS.—Water sufficient to irrigate approximately 1,000 acres near Pryor is diverted about 30 miles above Coburn.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by shift in control and by ice. Rating curve used October 1 to November 20 and April 8 to June 8 well defined between 14 and 282 second-feet; curve used June 19 to August 31 fairly well defined; shifting-control method used June 9-18 and September 1-30. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Pryor Creek at Coburn, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Dec. 5	[a]4.50	56.3
June 23	5.39	156
Aug. 9	4.33	37.2

[a] Stage discharge relation affected by ice.

Daily discharge, in second-feet, of Pryor Creek at Coburn, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	40	49		199	635	88	37	22
2	40	49		179	609	66	37	22
3	44	49		179	332	66	37	23
4	49	49		179	312	66	37	20
5	49	49		179	713	60	33	24
6	49	49		416	687	60	37	25
7	58	49		486	405	66	37	26
8	58	49	394	416	322	66	37	26
9	58	49	372	292	292	55	37	24
10	58	49	342	238	282	55	33	28
11	58	49	352	199	282	41	37	28
12	58	49	438	189	273	46	37	30
13	49		332	179	264	41	37	46
14	49		292	179	229	37	37	52
15	49		273	199	209	37	33	58
16	49		255	219	199	33	37	68
17	49		273	209	255	37	37	68
18	49		273	219	208	37	30	58
19	49		255	209	186	37	30	47
20	99		255	219	175	30	26	49
21	110		255	209	169	26	23	49
22	110		229	199	175	30	23	58
23	88		219	199	157	30	23	58
24	58		199	199	151	30	23	49
25	58		179	238	138	30	20	58
26	58		179	273	119	26	23	58
27	58		189	209	126	30	23	58
28	58		199	199	112	30	23	58
29	58		199	199	112	30	23	58
30	58		199	302	112	30	20	58
31	49			510		30	23	

Monthly discharge of Pryor Creek at Coburn, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	110	40	58.8	3,620
November 1-12	49	49	49.0	1,170
April 8-30	438	179	267	12,200
May	510	179	243	14,900
June	713	112	274	16,300
July	88	26	43.4	2,670
August	37	20	30.6	1,880
September	68	20	43.5	2,590

WIND RIVER AT RIVERTON, WYO.

LOCATION.—In sec. 2, T. 1 S., R. 4 E., at highway bridge three-fourths of a mile east of Riverton, in Fremont County. Popo Agie River enters three-fourths of a mile below.

DRAINAGE AREA.—2,320 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 15, 1911, to October 31, 1912; April 1, 1915, to September 30, 1917. From May 14, 1906, to November 1, 1908, a station was maintained at Walker's ferry about 1 mile above present station. No streams enter between the sites; records directly comparable.

GAGE.—Friez water-stage recorder installed April 4, 1917; referred to chain gage on downstream side of first pier bent from left. This chain gage used previous to installation of recorder.

DISCHARGE MEASUREMENTS.—Made from bridge.

CHANNEL AND CONTROL.—Channel composed of sand and gravel; high water during 1917 formed large sand bar just below gage completely changing the control. Right bank will overflow at extreme high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 10.9 feet at 7.30 a. m. July 1 (discharge, 9,530 second-feet); minimum discharge occurs during winter.

ICE.—Stage-discharge relation seriously affected by ice.

DIVERSIONS.—Water is diverted from Wind River and its tributaries for the irrigation of approximately 27,000 acres. Under the Wyoming law of 1 second-foot for 70 acres, this would require 386 second-feet.

REGULATION.—None.

ACCURACY.—Stage-discharge relation shifted seriously during high water of 1917; affected by ice during winter. Rating curve used October 1 to July 31 well defined between 300 and 8,000 second-feet; and curve used August 1 to September 30 fairly well defined between 400 and 3,000 second-feet. Gage read to quarter-tenths October 1 to November 11. Operation of the water-stage recorder was satisfactory April 4 to September 30. Daily discharge ascertained by applying to the rating table mean daily gage height determined from two daily gage readings and by inspecting the gage-height graph. Records excellent, except for periods June 20 to August 15 when they are fair, and August 16 to September 30 when they are good.

Discharge measurements of Wind River at Riverton, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 6	H. K. Smith	4.88	552	July 5	P. V. Hodges	10.8	9,310
Apr. 4	P. V. Hodges	4.52	393	Sept. 14	.....do	7.29	995
May 4	.....do	4.45	381				

Daily discharge, in second-feet, of Wind River at Riverton, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	478	498	....	422	1,890	9,080	2,870	1,230
2	478	540	....	422	1,740	7,540	2,740	1,230
3	478	459	....	422	1,780	7,120	2,420	1,150
4	540	498	404	387	1,640	7,120	2,180	1,110
5	586	478	459	422	1,510	8,420	2,120	1,110
6	562	440	498	440	1,420	8,640	2,180	1,190
7	562	387	518	422	1,470	8,420	2,010	1,280
8	610	404	518	478	1,640	8,200	1,850	1,410
9	586	404	562	459	2,090	8,200	1,700	1,360
10	562	404	692	459	3,600	7,540	1,600	1,320
11	562	440	586	540	4,340	7,120	1,550	1,190
12	586	....	478	753	3,600	6,500	1,600	1,110
13	586	....	498	1,010	3,060	5,910	1,600	1,040
14	586	....	478	1,300	2,570	7,540	1,550	965
15	586	....	498	2,090	2,850	4,980	1,550	1,000
16	586	....	459	2,640	4,000	4,620	1,550	1,000
17	562	....	422	2,380	5,530	4,450	1,500	930
18	586	....	422	2,090	6,700	4,450	1,460	895
19	610	....	404	2,140	7,540	4,450	1,550	860
20	562	....	387	2,570	7,330	4,620	1,550	828
21	518	....	387	2,640	7,120	4,620	1,460	795
22	564	....	478	2,200	7,880	4,450	1,460	795
23	610	....	562	2,090	8,640	4,260	1,460	795
24	540	....	562	1,980	8,420	4,450	1,410	795
25	540	....	610	1,930	8,420	4,260	1,360	860
26	562	....	610	1,930	8,640	4,090	1,360	930
27	586	....	692	1,930	7,980	3,920	1,460	930
28	586	....	540	1,740	8,420	3,920	1,650	828
29	586	....	498	1,830	8,860	3,920	1,560	762
30	518	....	459	2,090	8,420	3,760	1,410	762
31	518	....	....	2,040	....	3,290	1,320	....

NOTE.—July 6-31, discharge computed by the shifting-control method.

Monthly discharge of Wind River at Riverton, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	610	478	561	34,500
November 1-11	540	387	450	9,820
April 4-30	692	387	507	27,200
May	2,640	387	1,430	87,900
June	8,860	1,420	4,970	296,000
July	9,080	3,290	5,800	357,000
August	2,870	1,320	1,710	105,000
September	1,410	762	1,020	60,700

BIG HORN RIVER AT THERMOPOLIS, WYO.

LOCATION.—In sec. 36, T. 43 N., R. 95 W., at highway bridge between Thermopolis and Hot Springs, Hot Springs County. Nearest tributary, Buffalo Creek, enters 3 miles upstream.

DRAINAGE AREA.—8,080 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 28, 1900, to December 31, 1905; June 30, 1910, to October 7, 1912; April 1, 1915, to September 30, 1917. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Chain gage on downstream handrail on bridge, installed May 4, 1916, at datum 1 foot lower than staff gage used previously; read by Mrs. H. E. Holdrege and Miss Florence Erlos.

DISCHARGE MEASUREMENTS.—Made from two-span bridge.

CHANNEL AND CONTROL.—Channel composed of coarse gravel and small boulders. Control a short distance below gage; practically permanent. High-water control is vertical walls of canyon entrance half a mile downstream. Banks high and not subject to overflow.

EXTREMES OF DISTANCE.—Maximum stage recorded during year, 13.4 feet at 7 p. m. June 24, and 6 p. m. June 27 (discharge, 19,400 second-feet); minimum discharge occurs during winter.

ICE.—Stage-discharge relation affected by ice. Records discontinued during winter.

DIVERSIONS.—Prior to December 31, 1916, there were adjudications of 41 second-feet from Big Horn River above station and 202 second-feet below. In addition there is an adjudicated diversion of 366 second-feet for power above station.

REGULATION.—None.

ACCURACY.—Stage-discharge practically permanent; affected by ice during winter. Rating curve well defined between 800 and 17,000 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying the mean daily gage height to rating table. Records excellent.

Discharge measurements of Big Horn River at Thermopolis, Wyo., during the year ending Sept. 30, 1917.

[Made by P. V. Hodges].

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
May 7	2.02	1,030
July 1	11.92	16,800
Sept. 18	2.42	1,400

Daily discharge, in second-feet, of Big Horn River at Thermopolis, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	720	890	510	....	1,740	1,280	3,520	16,900	5,170	1,880
2	760	890	535	....	1,080	980	3,360	16,700	4,340	1,740
3	800	890	562	....	650	890	3,360	15,700	3,850	1,740
4	800	890	590	....	980	935	3,520	14,400	3,520	1,880
5	800	800	650	....	935	935	3,520	12,400	3,020	1,880
6	800	800	650	....	1,080	980	3,520	13,100	2,860	1,880
7	845	760	720	....	1,030	1,030	3,360	13,700	2,860	1,880
8	890	650	650	....	1,230	1,080	3,360	14,100	2,530	1,880
9	890	650	535	....	1,130	1,080	3,520	13,700	2,530	1,880
10	890	590	423	....	1,080	1,080	4,510	13,700	2,360	1,880
11	890	590	375	....	1,230	1,030	6,820	13,600	2,360	1,880
12	935	535	423	....	1,230	1,080	8,140	11,400	2,200	1,880
13	935	423	350	....	1,500	1,390	7,480	10,400	2,040	1,740
14	935	405	....	562	1,280	1,880	5,830	10,100	1,880	1,620
15	890	405	....	562	1,180	2,360	6,490	9,300	1,880	1,500
16	935	390	....	562	1,230	3,520	8,140	8,300	1,880	1,500
17	980	462	....	535	1,130	4,340	8,140	7,810	2,040	1,500
18	980	535	....	590	980	4,180	10,600	7,640	2,040	1,390
19	980	720	....	590	890	4,020	13,100	7,150	2,360	1,390
20	1,030	890	....	620	845	4,510	16,100	6,160	2,360	1,280
21	1,030	935	....	685	890	5,500	17,400	6,160	2,200	1,230
22	1,030	800	....	590	980	6,000	17,900	6,000	2,040	1,230
23	1,030	760	....	590	1,080	4,680	18,200	6,000	1,880	1,180
24	1,030	590	....	685	1,130	4,680	19,400	5,830	1,880	1,180
25	980	650	....	720	1,280	4,840	19,000	5,830	1,880	1,180
26	980	620	....	650	1,500	4,840	19,000	5,830	1,740	1,280
27	980	590	....	685	1,390	4,840	19,400	5,660	1,880	1,390
28	935	562	....	720	1,500	4,510	18,500	5,660	1,880	1,390
29	925	535	....	1,080	1,390	4,180	17,700	5,340	2,530	1,280
30	935	535	....	1,280	1,130	3,680	17,000	5,340	2,360	1,280
31	935	....	....	2,200	....	3,520	....	5,340	2,040	....

Monthly discharge of Big Horn River at Thermopolis, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	1,030	720	919	56,500
November	935	390	658	39,200
December 1-13	720	350	536	13,800
March 14-31	2,200	535	773	27,600
April	1,740	650	1,160	69,000
May	6,000	890	2,900	178,000
June	19,400	3,360	10,300	613,000
July	16,900	5,340	9,650	593,000
August	5,170	1,740	2,460	151,000
September	1,880	1,180	1,560	92,800

BIG HORN RIVER NEAR HARDIN, MONT.

LOCATION.—In SW. ¼ sec. 13, T. 1 S., R. 33 E., at bridge of Chicago, Burlington & Quincy Railroad on Crow Indian Reservation, half a mile above junction of Big Horn and Little Horn rivers, 2 miles from Hardin, in Big Horn County.

DRAINAGE AREA.—20,700 square miles.

RECORDS AVAILABLE.—June 16, 1904, to September 30, 1917.

GAGE.—Chain gage attached to west span, upstream side of railroad bridge; read by H. R. Kean. A temporary staff gage 20 feet farther downstream was used October 11 to November 22, 1913, and the readings reduced to datum of chain gage.

DISCHARGE MEASUREMENTS.—Made from railroad bridge.

CHANNEL AND CONTROL.—Stream bed gravel; free from vegetation; slightly shifting. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.90 feet June 26 (discharge, 36,700 second-feet); minimum discharge recorded, 625 second-feet by current-meter measurement January 25.

1904–1917: Maximum stage recorded, 9.8 feet June 17, 1908 (discharge, 40,800 second-feet); minimum discharge recorded that of January 15, 1917.

ICE.—Stage-discharge relation seriously affected by ice December 9, 1916, to March 24, 1917.

DIVERSIONS.—Water is diverted a few miles above station, by a private irrigation company, to irrigate land on west side of river. Water is also diverted from Shoshone River at Corbett dam, Wyo., by United States Reclamation Service, and many private ditches divert water from tributaries above station.

REGULATION.—Shoshone reservoir above Cody controls flow of Shoshone River, an important tributary of the Big Horn.

ACCURACY.—Stage-discharge relation affected by ice and by shifting control. Rating curve used October 1 to December 8 fairly well defined between 3,020 and 14,500 second-feet; curve used March 25 to July 1 well defined between 800 and 34,000 second-feet; July 6 to September 30 well defined between 1,600 and 8,000 second-feet; shifting control method used July 2–5. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Discharge December 9 to March 24 determined from observer's notes, weather records, and six discharge measurements. Records good for open flow; only fair for winter.

Discharge measurements of Big Horn River near Hardin, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 1	W. A. Lamb	[a] 3.58	2,140	Mar. 16	W. A. Lamb	[a] 5.37	1,780
29	....do	[a] 5.67	1,020	May 27	....do	5.87	10,100
Jan. 15	A. H. Tuttle	[a] 5.12	625	June 22	....do	9.47	[b] 33,200
Feb. 3	W. A. Lamb	[a] 5.07	1,740	Aug. 9	....do	5.25	4,830
Mar. 3	....do	[a] 5.82	2,040				

[a] Stage-discharge relation affected by ice.
[b] Velocity determined by surface method applying a coefficient of 0.90 to obtain mean velocity.

Daily discharge, in second-feet, of Big Horn River near Hardin, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,940	2,450	2,140	....	18,600	4,300	12,200	35,200	8,330	3,800
2	2,640	3,070	2,140	....	11,100	3,530	10,100	32,200	8,120	3,950
3	1,940	2,780	•2,140	....	9,200	2,840	9,200	29,300	7,480	3,800
4	2,140	2,340	2,240	....	8,320	3,100	8,320	26,500	6,450	3,950
5	2,140	2,140	2,560	....	6,720	3,100	8,110	23,000	6,260	3,800
6	1,940	2,240	2,340	....	4,300	3,980	11,100	23,000	5,860	3,520
7	2,140	2,240	2,140	....	4,300	3,680	10,600	23,000	5,120	3,800
8	2,240	1,940	1,850	....	3,980	3,680	10,100	22,300	5,120	3,800
9	2,100	2,140	....	....	4,300	3,240	7,500	23,700	5,120	3,660
10	2,300	2,140	....	....	4,620	3,380	8,110	23,700	5,120	3,260
11	2,340	2,140	....	....	4,780	3,380	9,430	23,400	4,260	3,260
12	2,340	1,940	....	....	4,620	3,380	11,900	22,000	4,420	3,390
13	2,240	2,140	....	....	3,830	3,240	14,400	22,000	4,100	3,260
14	2,450	1,010	....	....	3,980	3,980	13,600	20,700	3,660	3,520
15	2,340	1,140	....	....	3,980	4,620	11,400	18,400	3,800	3,520
16	2,140	1,590	....	....	3,680	6,160	10,900	17,800	3,800	3,260
17	2,340	1,760	....	....	4,140	8,320	12,500	16,600	3,390	3,520
18	2,340	1,940	....	....	3,980	10,100	12,200	14,300	3,520	3,520
19	2,140	2,240	....	....	3,380	10,600	23,300	13,700	3,520	3,520
20	2,340	2,340	....	....	3,680	11,100	29,100	13,200	3,660	3,260
21	2,450	2,340	....	4,660	3,380	10,600	29,100	12,100	3,520	3,520
22	2,560	2,240	....	5,560	3,100	12,700	32,100	11,900	3,800	3,520
23	2,450	2,140	....	8,060	2,720	12,500	32,800	12,100	3,800	3,000
24	2,900	2,040	....	12,400	3,100	11,900	33,600	12,100	3,520	3,130
25	2,780	1,760	....	17,300	3,240	10,600	33,600	11,400	3,800	3,130
26	2,450	2,140	....	17,300	3,100	9,660	36,700	11,100	3,800	2,550
27	2,780	2,560	....	16,700	3,680	10,100	34,400	11,100	3,520	2,660
28	3,020	2,240	....	18,600	4,620	10,100	33,200	9,920	3,800	2,550
29	2,670	2,340	....	18,600	4,460	10,100	33,600	10,200	3,660	2,550
30	2,670	2,240	....	18,600	4,620	11,900	33,600	9,680	3,660	2,340
31	2,560	....	....	29,100	....	11,900	....	9,000	3,390	....

NOTE.—Discharge estimated because of ice as follows:

	Second-feet.		Second-feet.
Dec. 9-15	1,440	Feb. 1-10	1,840
Dec. 16-28	1,100	Feb. 11-20	2,250
Dec. 29-31	1,020	Feb. 21-28	1,580
Jan. 1-10	1,320	Mar. 1-10	2,230
Jan. 11-20	880	Mar. 11-20	2,240
Jan. 21-31	1,250		

Monthly discharge of Big Horn River near Hardin, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	3,020	1,940	2,360	145,000
November	3,070	1,010	2,130	127,000
December	....	....	1,450	89,200
January	....	....	1,150	70,700
February	....	....	1,910	106,000
March	29,100	....	6,820	419,000
April	18,600	2,720	5,050	300,000
May	12,700	2,840	7,150	440,000
June	36,700	7,500	19,200	1,140,000
July	35,200	9,000	18,200	1,120,000
August	8,330	3,390	4,560	280,000
September	3,950	2,340	3,340	199,000
The year	36,700	....	6,130	4,440,000

POPO AGIE RIVER BELOW ARAPAHOE, WYO.[1]

Location.—In sec. 23, T. 1 S., R. 3 E., at highway bridge half a mile below Arapahoe, Fremont County. Nearest tributary, Little Wind River, enters 200 yards above. Popo Agie River joins Wind River 6 miles below to form Big Horn River.

Drainage area.—1,530 square miles (measured on base map of Wyoming, scale 1:500,000).

Records available.—May 11, 1906, to November 27, 1909; May 14, 1911, to October 31, 1912; April 1, 1915, to September 30, 1917.

Gage.—Vertical staff on downstream side of first pier from left bank; read by R. H. Knox. From June 19 to July 19, 1911, a temporary gage was used with datum 2.95 feet higher; during 1915, a temporary gage was used with datum 0.55 foot higher. All readings have been reduced to the original datum.

Discharge measurements.—Made from highway bridge or by wading.

Channel and control.—Bed composed of sand and gravel. Control slightly shifting from year to year. Right bank will be overflowed at high water.

Extremes of discharge.—Maximum stage recorded during year, 9.3 feet for several days during latter part of June from high-water mark (discharge, 9,710 second-feet); minimum discharge probably occurs during winter.

Diversions.—Between this station and that on Little Wind above Arapahoe, there were adjudicated diversions of 583 second-feet from the Popo Agie and its tributaries, prior to December 31, 1916.

Regulation.—None.

Accuracy.—Stage-discharge relation slightly shifting; affected by ice during winter. Rating curve used October 1 to November 9 well defined between 100 and 400 second-feet; curve used April 1 to September 30 well defined between 200 and 6,000 second-feet but not well defined above 6,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent up to 6,000 second-feet; above this they are fair.

Discharge measurements of Popo Agie River below Arapahoe, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 6	H. K. Smith	1.34	186	July 5	P. V. Hodges	6.70	5,100
May 3	P. V. Hodges	1.77	344	Sept. 15	.....do	1.89	390

[1] Formerly known as Little Wind River below Arapahoe, Wyo.

Daily discharge, in second-feet, of Popo Agie River below Arapahoe, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	96	252	282	318	1,280	7,100	926	486
2	101	235	282	318	1,280	5,120	804	440
3	136	235	282	356	1,360	4,610	690	396
4	156	235	248	318	1,440	4,610	584	356
5	204	220	248	337	1,520	5,120	584	356
6	204	220	300	356	1,440	5,460	584	396
7	220	176	265	463	1,600	5,120	584	463
8	340	164	265	396	1,690	5,290	610	510
9	322	176	300	356	2,360	4,950	440	510
10	303	....	337	318	3,480	4,440	396	463
11	286	....	356	318	3,480	4,100	396	440
12	286	....	356	396	3,100	3,770	396	440
13	268	....	356	510	2,460	3,480	376	418
14	268	....	356	690	2,360	3,100	376	396
15	268	....	356	990	2,870	2,760	376	376
16	252	....	337	1,280	4,100	2,560	356	396
17	252	....	300	1,280	5,290	2,560	376	376
18	235	....	300	1,280	6,650	2,360	376	356
19	268	....	282	1,280	8,520	2,360	418	318
20	252	....	248	1,960	8,860	2,360	440	300
21	286	....	248	2,260	8,860	2,160	418	300
22	322	....	248	1,600	9,250	2,060	396	282
23	322	....	300	1,360	9,710	1,780	356	282
24	235	....	376	1,360	9,710	1,870	337	356
25	268	....	396	1,360	9,500	1,780	337	418
26	322	....	396	2,060	9,710	1,600	300	418
27	322	....	463	1,870	8,800	1,440	318	418
28	303	....	396	1,520	7,900	1,360	510	376
29	303	....	356	1,520	7,000	1,440	559	356
30	252	....	337	1,600	7,300	1,280	559	318
31	235	....	....	1,440	....	1,130	486	....

NOTE.—June 22–July 2, gage could not be read on account of high water. Maximum stage of 9.3 feet from water marks, and length of time water remained at this stage from testimony of observer.

Monthly discharge of Popo Agie River below Arapahoe, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	340	96	254	15,600
November 1–9	252	164	213	3,800
April	463	248	319	19,000
May	2,260	318	1,020	62,700
June	9,710	1,280	5,100	303,000
July	7,100	1,130	3,200	197,000
August	926	300	473	29,100
September	510	282	391	23,300

LITTLE POPO AGIE RIVER AT HUDSON, WYO.

LOCATION.—About sec. 12, T. 2 S., R. 2 E., at highway bridge three-eighths of a mile southwest of Hudson, Fremont County. No tributary between station and mouth of river, half a mile below.

DRAINAGE AREA.—346 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—August 26, 1907, to December 31, 1909; June 19, 1911, to October 31, 1912; April 1, 1915, to September 30, 1917.

GAGE.—Vertical staff on downstream side of center pier of bridge, installed August 25, 1915, at datum 1 foot higher than that of original gage, a vertical staff attached to right abutment and used from August 26, 1907, to June 12, 1908; June 13, 1908, chain gage was installed 100 yards downstream from bridge and at a new datum; chain gage was abandoned July 24, 1912, and readings were resumed on the original gage, which was also used from April 1 to August 25, 1915. Gage read by Mrs. A. C. Ladd.

Discharge measurements.—Made from bridge or by wading.

Channel and control.—Bed composed of sand and gravel washed in from new channel cut above station during winter of 1915. Control is at gage; permanent during 1917.

Extremes of discharge.—Maximum stage recorded during year, 6.6 for about one week, June 19–26, as determined by leveling to high-water marks (discharge, 1,490 second-feet); minimum discharge occurs during winter.

Ice.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

Diversions.—Prior to December 31, 1916, adjudicated diversions from Little Popo above the station amounted to 50 second-feet.

Regulation.—None.

Accuracy.—Stage-discharge relation practically permanent; affected by ice during winter. Rating curve well defined between 40 and 800 second-feet but poorly defined above 800 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent up to 800 second-feet; above this they are fair.

Discharge measurements of Little Popo Agie River at Hudson, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 7	H. K. Smith	0.94	61	July 4	P. V. Hodges	4.12	715
May 3	P. V. Hodges	1.50	122	Sept. 15	.....do	.98	64

Daily discharge, in second-feet, of Little Popo Agie River at Hudson, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	46	46	84	112	347	1,160	112	74
2	46	46	84	106	325	943	100	68
3	56	46	79	118	347	798	88	66
4	56	46	67	100	393	740	82	64
5	56	46	84	106	441	769	82	60
6	56	46	106	106	393	827	82	64
7	60	42	86	146	417	769	77	67
8	94	42	90	118	441	740	74	72
9	79	44	118	100	517	740	66	64
10	68	....	139	94	682	653	61	62
11	66	....	154	94	798	543	58	60
12	64	....	146	118	856	570	59	60
13	62	....	162	146	653	491	64	58
14	56	....	154	204	597	441	70	57
15	54	....	132	282	682	393	65	60
16	52	....	100	370	769	370	66	65
17	46	....	96	370	972	325	64	68
18	45	....	100	325	1,230	303	65	66
19	48	....	94	325	1,300	282	76	64
20	44	....	87	491	1,400	282	82	62
21	54	....	88	625	1,490	261	82	65
22	54	....	100	466	1,490	241	77	66
23	56	....	125	347	1,490	222	73	62
24	44	....	154	370	1,490	213	73	64
25	46	....	154	347	1,490	196	70	67
26	56	....	139	653	1,390	178	65	72
27	56	....	154	570	1,290	154	73	69
28	52	....	125	466	1,230	154	100	68
29	50	....	112	441	1,190	162	100	66
30	46	....	100	441	1,190	146	94	64
31	45	....	....	417	....	139	82	....

Note.—June 19–26 gage could not be read on account of high water. Maximum stage 6.6 feet from water marks, and continued for nearly a week, according to statements by observer.

Monthly discharge of Little Popo Agie River at Hudson, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	94	44	55.3	3,400
November 1-9	46	42	44.9	802
April	162	67	114	6,780
May	653	94	289	17,800
June	1,490	325	910	54,100
July	1,160	139	458	28,200
August	112	58	76.8	4,720
September	74	57	64.8	3,860

LITTLE WIND RIVER ABOVE ARAPAHOE, WYO.

Location.—In sec. 23, T. 1 S., R. 3 E., at railroad bridge opposite Indian subagency, a quarter of a mile above Arapahoe, Fremont County. Little Wind River enters Popo Agie River a quarter of a mile below station.

Drainage area.—716 square miles (measured on base map of Wyoming; scale, 1:500,000).

Records available.—May 14, 1911, to October 31, 1912; April 1, 1915, to September 30, 1917. From May 11, 1906, to December 17, 1909, a station was maintained a short distance above present one. The flow at the two points is comparable.

Gage.—Chain gage on upstream side of railroad bridge; read by R. H. Knox.

Discharge measurements.—Made from single-span bridge.

Channel and control.—Channel composed of sand and gravel. Control a short distance downstream; shifted slightly during 1917. Banks high and not subject to overflow.

Extremes of discharge.—Maximum stage recorded during year, 6.25 feet, mornings of June 23, 24, and 26 (discharge, 3,280 second-feet). Records discontinued during winter, when minimum discharge probably occurs.

Ice.—Stage-discharge relation seriously affected by ice; records discontinued during winter.

Diversions.—Water is diverted from Little Wind River and tributaries for the irrigation of approximately 52,000 acres. Under the Wyoming law of 1 second-foot for 70 acres, this would require 742 second-feet.

Regulation.—None.

Accuracy.—Stage-discharge relation not permanent; affected by ice during winter. Rating curve well defined between 40 and 3,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except for periods April 8 to May 31 and July 16 to September 30, when discharge was computed by the shifting-control method. Records good.

Discharge measurements of Little Wind River above Arapahoe, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 7	H. K. Smith	2.00	49.7	July 5	P. V. Hodges	5.08	1,780
May 3	P. V. Hodges	2.46	110	Sept. 15	do	2.96	164

Daily discharge, in second-feet, of Little Wind River above Arapahoe, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	25	73	....	103	390	2,640	500	192
2	24	72	....	103	390	1,980	418	175
3	24	72	....	107	418	1,870	318	160
4	30	72	....	101	445	1,870	272	145
5	39	72	....	112	390	1,980	250	122
6	46	72	....	122	390	2,340	210	145
7	46	65	....	140	418	2,220	145	175
8	68	59	88	154	472	2,220	110	210
9	74	60	88	130	625	2,220	110	230
10	72	64	90	114	1,160	1,980	94	210
11	72	44	92	112	1,080	1,870	94	210
12	72	54	86	145	955	1,870	94	210
13	72	56	86	210	840	1,760	94	175
14	78	44	86	318	765	1,540	94	175
15	84	....	98	418	878	1,440	94	160
16	76	....	107	530	1,260	1,260	82	160
17	74	....	96	472	1,650	1,260	80	160
18	74	....	92	472	2,100	1,260	86	145
19	81	....	86	472	2,700	1,260	132	132
20	76	....	81	730	2,960	1,260	160	122
21	84	....	81	955	2,960	1,080	132	120
22	89	....	80	592	3,090	995	132	110
23	90	....	82	500	3,220	955	132	110
24	81	....	98	472	3,320	878	110	120
25	89	....	118	472	3,090	840	145	160
26	98	....	118	660	3,220	802	132	175
27	92	....	166	625	2,960	730	145	175
28	90	....	135	500	2,700	730	210	160
29	86	....	118	530	2,580	730	230	160
30	80	....	110	560	2,700	695	230	132
31	74	....	....	472	....	625	230	....

Monthly discharge of Little Wind River above Arapahoe, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	98	24	69.7	4,290
November 1-14	78	44	63.1	1,750
April 8-30	166	80	99.2	4,530
May	955	101	368	22,600
June	3,220	390	1,670	99,400
July	2,640	625	1,460	89,800
August	500	80	170	10,500
September	230	110	162	9,640

OWL CREEK NEAR THERMOPOLIS, WYO.

LOCATION.—About sec. 16, T. 43 N., R. 95 W., at Whetstine's ranch 6 miles northwest of Thermopolis, Hot Springs County. No tributary between station and mouth.

DRAINAGE AREA.—463 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—July 30, 1910, to October 31, 1912; April 1, 1915, to November 30, 1917, when station was discontinued. Station maintained by State engineer during 1913 and 1914.

GAGE.—Slope gage installed October 13, 1915, at footbridge 50 feet downstream from chain gage used by State engineer, and referred to same datum; read by W. E. Whetstine. Owing to slope of creek, slope gage reads approximately 0.1 foot lower. Chain gage on upstream side of highway bridge a quarter of a mile above used from 1910 to 1912. No definite relation between the gage readings.

DISCHARGE MEASUREMENTS.—Made from footbridge or by wading.

CHANNEL AND CONTROL.—Bed composed of compact gravel. Control 100 feet downstream at small rapids which remained fairly permanent during 1917. Right bank not subject to overflow; left bank is overflowed at stage about 6.6 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.8 feet at 7 p. m. June 17 (discharge, 980 second-feet); minimum discharge occurs during winter.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 116 second-feet from Owl Creek above station and 66 second-feet below.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice during winter. Rating curve well defined up to 600 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records probably good; reliability of gage-height record questioned.

Discharge measurements of Owl Creek near Thermopolis, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 3	H. K. Smith	1.82	[a] 2.0	July 1	P. V. Hodges	4.12	259
May 6	P. V. Hodges	2.32	32.5	1	do	4.18	260
8	do	2.38	35.2	Sept. 18	do	1.49	.94

[a] Estimated.

Daily discharge, in second-feet, of Owl Creek near Thermopolis, Wyo., for the period Oct. 1, 1916, to Nov. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	5	7		33	149	315	11	0.9	0.6	10.8
2	7	7		27	216	265	12	2.0	.6	10.0
3	7	7		27	216	226	8.5	3.0	1.3	10.0
4	7	7		33	207	198	4.6	3.0	4.0	10.0
5	8			30	207	149	4.0	3.0	4.0	12.0
6	7			26	236	129	4.6	3.0	4.0	10.0
7	7			16	216	106	3.6	3.0	4.0	10.0
8	7			22	245	142	1.7	3.0	4.0	12.0
9	7			6	207	129	1.7	2.8	4.0	10.8
10	4			9	189	90	4.0	2.4	4.0	10.0
11	4			63	315	40	3.0	2.4	3.0	10.8
12	4			129	465	37	3.0	2.4	3.6	10.0
13	7			106	216	28	3.6	2.4	4.0	10.0
14	7			265	226	22	4.0	3.0	4.0	12.0
15	10			515	315	14	4.0	2.0	4.60	12.0
16	14			465	440	8	4.0	2.0	7.0	13.2
17	19			123	740	6	2.4	1.2	8.5	10.0
18	19			164	740	14	4.6	.5	10.0	10.0
19	18			265	740	15	5.2	.6	10.0	10.0
20	18			180	740	13	3.6	5.5	10.0	14.8
21	19			129	710	13	3.2	4.6	10.0	10.8
22	14			156	740	24	3.2	4.6	10.0	10.0
23	8			172	680	22	3.0	.6	10.0	10.8
24	7			172	590	24	3.0	.6	10.0	14.0
25	7			189	565	20	3.0	.6	10.0	14.0
26	8			156	650	36	3.2	.6	9.4	15.0
27	10			136	415	16	3.2	.6	8.5	12.0
28	8			198	315	44	3.0	.6	10.0	14.0
29	7		30	226	290	31	3.0	.6	12.0	14.0
30	8		29	226	340	22	3.0	.6	13.2	14.0
31	10			164		25	3.0		14.0	

Monthly discharge of Owl Creek, near Thermopolis, Wyo., for the period Oct. 1, 1916, to Nov. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1916.				
October	19	4	9.4	578
1917.				
May	515	6	143	8,790
June	740	149	411	24,500
July	315	6	71.7	4,410
August	12	1.7	4.09	251
September	5.5	.5	2.07	153
October	14.0	.6	6.85	421
November	15.0	10.0	11.6	690

NO WOOD CREEK AT BONANZA, WYO.

LOCATION.—In sec. 13, T. 49 N., R. 91 W., at Bonanza, Big Horn County. Nearest tributary, Paintrock Creek, enters some distance above.

DRAINAGE AREA.—1,790 square miles (measured on base map of Wyoming, scale 1:500,000).

RECORDS AVAILABLE.—July 29, 1910, to October 31, 1912; April 1, 1915, to September 30, 1917.

GAGE.—Chain on left bank 1,000 feet below the store at Bonanza; read by Mrs. W. E. Taylor. Datum may be slightly different from that used 1910 to 1912, as bench mark had been destroyed and there was no means of checking the old gage.

DISCHARGE MEASUREMENTS.—Made from two-span highway bridge a quarter of a mile below gage or by wading.

CHANNEL AND CONTROL.—Bed of channel composed of gravel. Control 100 feet downstream at small rapids, which shift between narrow limits.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.2 feet at 8 a. m. June 18 (discharge, 3,480 second-feet); minimum discharge probably occurred during winter.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 80 second-feet from No Wood Creek above station and 42 second-feet below; all for irrigation. In addition, there is a decree for a power diversion of 115 second-feet below.

ACCURACY.—Stage-discharge relation shifts slightly at long intervals; rating curve well defined throughout; gage read to quarter-tenths once daily. Daily discharge ascertained by applying daily gage heights to rating table. Records good.

Discharge measurements of No Wood Creek at Bonanza, Wyo., during the year ending Sept. 30, 1917.

[Made by P. V. Hodges.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
May 10	2.98	282	Aug. 4	2.50	132
June 29	5.92	2,430	Sept. 21	2.75	197

Daily discharge, in second-feet, of No Wood Creek at Bonanza, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	122	246	....	310	1,100	1,170	143	108
2	136	229	....	290	1,030	1,240	143	118
3	150	229	....	271	1,240	1,380	143	130
4	196	212	....	271	1,170	1,380	130	143
5	212	229	....	290	1,100	1,740	115	143
6	229	229	....	290	1,030	1,590	90	143
7	212	229	....	310	960	1,520	90	130
8	212	212	895	290	1,030	1,240	90	130
9	246	212	960	353	1,030	1,240	78	128
10	264	212	830	353	2,320	1,240	78	115
11	246	180	530	353	2,500	1,100	78	115
12	246	212	530	353	1,820	960	76	128
13	229	212	449	645	1,450	960	56	128
14	212	....	353	895	1,240	895	56	128
15	229	....	399	1,450	1,450	645	46	115
16	212	....	399	2,230	1,960	585	46	179
17	196	....	353	2,500	2,680	502	37	195
18	180	....	353	2,320	3,480	530	100	195
19	180	....	310	2,410	3,080	585	271	195
20	165	....	290	2,590	3,080	530	331	195
21	150	....	271	2,880	3,080	475	310	201
22	282	....	271	2,590	3,080	475	310	201
23	282	....	353	1,900	2,780	423	201	185
24	320	....	530	1,820	2,680	449	201	185
25	383	....	765	1,660	2,880	423	148	185
26	282	....	502	1,740	2,500	423	217	185
27	264	....	399	1,660	2,230	375	201	201
28	246	....	310	1,450	2,140	375	201	201
29	264	....	271	1,520	2,320	217	173	185
30	264	....	310	1,380	2,230	201	159	201
31	246	....	....	1,170	....	156	120	....

Monthly discharge of No Wood Creek at Bonanza, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	383	122	228	14,000
November 1-13	246	180	219	5,650
April 8-30	960	271	462	21,100
May	2,880	271	1,240	76,200
June	3,480	960	2,020	120,000
July	1,740	156	807	49,600
August	331	37	143	8,790
September	201	108	160	9,520

TENSLEEP CREEK NEAR TENSLEEP, WYO.

LOCATION.—In sec. 12, T. 47 N., R. 88 W., 800 feet east of county bridge at Burke's ranch, 5 miles above Tensleep, Washakie County. Nearest tributary, Canyon Creek, enters a quarter of a mile upstream.

DRAINAGE AREA.—228 square miles (measured on base map of Wyoming; scale, 1:500,000.

RECORDS AVAILABLE.—September 21, 1910, to December 31, 1912; April 19, 1915, to September 30, 1917.

GAGE.—Inclined staff on left bank, 800 feet above county bridge, opposite vertical rock cliff; read by Lynn Burke.

DISCHARGE MEASUREMENTS.—Made from cable 100 feet below gage or by wading.

CHANNEL AND CONTROL.—Bed composed of coarse gravel and small boulders. Control just below gage at rapids; fairly permanent in 1917. Right bank is vertical rock cliff; left bank subject to overflow at extremely high water.

Extremes of discharge.—Maximum stage recorded during year, 5.8 feet at 7 a. m. June 18 (discharge, 1,860 second-feet); minimum stage occurs during winter.

Ice.—Stage-discharge relation not seriously affected by ice. Open-channel rating curve assumed applicable.

Diversions.—There is a diversion of approximately 8 second-feet for power above the station. Prior to December 31, 1916, there were adjudicated diversions of 35 second-feet for irrigation, all below station.

Regulation.—None.

Accuracy.—Stage-discharge relation slightly shifting; only slightly affected by ice. Rating curve well defined between 40 and 800 second-feet, not well defined above 800 second-feet. Gage read to hundredths once daily, except during high water when it is read twice daily. Daily discharge ascertained by applying daily gage reading or the mean of two daily gage readings to the rating table, except for period October 1 to January 20, when the discharge is computed by the shifting-control method. Records excellent below 800 second-feet and fair above.

Discharge measurements of Tensleep Creek near Tensleep, Wyo., during the year ending Sept. 30, 1917.

[Made by P. V. Hodges.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
May 10	1.11	51
June 29	3.78	909
Aug. 4	1.49	106

Daily discharge, in second-feet, of Tensleep Creek near Tensleep, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	69	64	69	62		51	52	372	1,060	128	106
2	84	62	65	62		52	55	388	1,060	118	99
3	80	63	66	62		50	52	388	1,110	108	99
4	79	64	66	63		62	50	420	1,010	108	90
5	72	64	68	63		76	52	340	960	90	84
6	89	65	64	61		66	49	294	960	128	76
7	101	63	66	60		54	54	309	865	90	83
8	120	62	65	62		52	60	420	775	84	74
9	101	65	68	62		54	58	640	685	83	68
10	94	66	64	63		53	62	1,010	560	87	69
11	84	64	66	64	50	62	83	1,060	525	64	66
12	80	52	65	60	51	63	108	600	525	59	70
13	79	50	65	56	50	65	128	388	490	52	71
14	76	55	66	57	51	64	190	372	490	54	118
15	75	69	64	58	52	70	324	685	455	51	128
16	74	64	65	57	54	60	455	1,110	420	53	84
17	74	65	66	57	50	59	490	1,560	420	50	83
18	75	71	65	59	50	64	560	1,760	420	64	86
19	77	69	66	58	49	62	640	1,310	388	214	83
20	80	68	63	59	50	66	775	1,460	372	253	99
21	84	66	65		51	58	600	1,460	372	202	90
22	87	70	64		51	61	420	1,310	340	138	90
23	74	69	66		52	59	455	1,060	324	128	90
24	72	71	64		53	60	490	1,360	309	128	90
25	69	71	71		60	64	455	1,410	294	108	99
26	66	74	66		90	56	455	1,260	266	118	99
27	66	72	64		148	54	490	1,160	240	128	90
28	64	71	65		227	55	525	910	227	118	90
29	63	68	64		128	53	490	865	214	108	83
30	66	66	65		54	54	404	640	168	118	76
31	64		63		52		356		158	118	

Note.—Stage-discharge relation affected by ice Jan. 12; discharge interpolated.

Monthly discharge of Tensleep Creek near Tensleep, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	120	63	78.6	4,830
November	74	50	65.4	3,890
December	71	63	65.5	4,030
January 1-20	64	56	60.2	2,390
March 11-31	227	49	70.1	2,920
April	76	50	59.3	3,530
May	775	49	304	18,700
June	1,760	294	877	52,200
July	1,110	158	531	32,600
August	253	50	108	6,640
September	128	66	87.8	5,220

PAINTROCK CREEK NEAR BONANZA, WYO.

Location.—About sec. 19, T. 49 N., R. 90 W., at Paumer's ranch, 1½ miles above Bonanza, Big Horn County. No tributary between station and mouth half a mile below.

Drainage area.—398 square miles (measured on base map of Wyoming; scale, 1:500,000).

Records available.—July 28, 1910, to October 31, 1912; April 19, 1915, to September 30, 1917.

Gage.—Chain on right bank 300 feet below ranch; read by Mrs. Wm. Paumer; used since April 11, 1917. From April 19, 1915, to November 18, 1916, staff gage at same location and datum. From July 28, 1910, to October 31, 1912, there was a chain gage near house. No definite relation between gages at two locations, as high water changed channel between.

Discharge measurements.—Made from cable 65 feet below gage or by wading nearby.

Channel and conrtol.—Bed composed of gravel; control at rapids composed of small boulders 150 feet below gage; somewhat shifting. The right bank is low and is overflowed at stage of 2 feet.

Extremes of discharge.—Maximum stage recorded during year, 4.2 feet at 7 a. m. June 17 (discharge, 2,180 second-feet); minimum discharge probably occurs during winter.

Ice.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

Diversions.—Prior to December 31, 1916, there were adjudicated diversions of 66 second-feet from Paintrock Creek, practically all being above station.

Regulation.—None.

Accuracy.—Stage-discharge relation slightly shifting; affected by ice during winter. Rating curve used October 1 to November 10 well defined between 20 and 200 second-feet; curve used April 11 to September 30 well defined between 20 and 1,800 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent.

Discharge measurements of Paintrock Creek near Bonanza, Wyo., during the year ending Sept. 30, 1917.

[Made by P. V. Hodges.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
May 10	1.42	60	Aug. 4	1.35	53
June 29	3.22	1,110	Sept. 20	1.48	78

Daily discharge, in second-feet, of Paintrock Creek near Bonanza, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	41	75		43	342	630	102	40
2	52	75		43	400	630	83	55
3	59	71		43	462	560	53	51
4	67	71		45	462	700	53	47
5	75	71		47	342	815	43	45
6	75	71		39	320	775	47	47
7	71	71		39	285	738	35	47
8	89	75		39	310	738	31	43
9	80	77		43	528	775	30	41
10	75	89		66	1,110	665	21	41
11	75		21	78	1,110	700	19	38
12	71		49	116	738	495	21	38
13	71		36	173	528	430	20	35
14	71		27	180	462	370	15	38
15	71		33	376	700	342	14	61
16	71		68	462	1,300	242	12	71
17	71		63	665	1,960	247	15	83
18	71		25	665	2,180	260	21	83
19	87		20	896	1,740	275	170	83
20	89		23	935	1,630	342	180	80
21	97		24	775	1,410	275	128	75
22	99		39	630	1.740	242	75	68
23	99		36	665	1,300	234	63	66
24	99		99	665	1,410	284	57	71
25	99		31	630	1,630	224	73	66
26	97		31	595	1,200	212	73	71
27	85		35	495	1,110	220	71	71
28	75		45	495	1,110	220	80	61
29	77		45	495	1,200	200	55	61
30	77		43	462	1,410	170	51	55
31	77			364		139	43	

Monthly discharge of Paintrock Creek near Bonanza, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	99	41	77.8	4,780
November 1-10	89	71	74.6	1,480
April 11-30	99	20	39.6	1,570
May	935	39	363	22,300
June	2,180	285	1,010	60,100
July	815	139	423	26,000
August	180	12	56.4	3,470
September	83	35	58.0	3,450

WOOD RIVER NEAR MEETEETSE, WYO.

Location.—Near line between secs. 26 and 27, T. 48 N., R. 101 W., 1,200 feet above mouth of Wood River and 7 miles southwest of Meeteetse, Park County.

Drainage area.—218 square miles (measured on base map of Wyoming; scale, 1:500,000).

Records available.—September 15, 1910, to October 31, 1912; May 10, 1915, to September 30, 1917, when station was discontinued.

Gage.—Chain gage on left bank 400 feet above bridge, used since April 25, 1916; read by Mrs. Adah River. Original gage, used during 1910–1912, was vertical staff at bridge. Vertical staff at bridge, but referred to different datum from original gage, used from May 10, 1915, to April 24, 1916.

Discharge measurements.—Made from cable short distance below gage.

Channel and control.—Channel composed of boulders; control a short distance below gage at small rapids; shifted considerably during 1917. Right bank will be overflowed at extremely high water.

EXTREMES OF STAGE.—Maximum stage recorded during year, 4.4 feet at 5 p. m. May 15; minimum discharge probably occurs during winter when records are discontinued.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 66 second-feet from Wood River.

REGULATION.—None.

ACCURACY.—Stage-discharge relation shifts seriously; affected by ice during winter. Rating curve used October 1 to November 11 well defined between 50 and 100 second-feet. Gage read to quarter-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good for October and November. Data inadequate for determination of discharge April 10 to September 30.

Discharge measurements of Wood River near Meeteetse, Wyo., during the year ending Sept. 30, 1917.

[Made by P. V. Hodges.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
May 16	3.55	587
June 24	3.50	969

Daily discharge, in second-feet, of Wood River near Meeteetse, Wyo., for the year ending Sept. 30, 1917

Day.	Oct.	Nov.	Day.	Oct.	Nov.	Day.	Oct.	Nov.
1	74	66	11	74	52	21	74	
2	74	66	12	74		22	74	
3	84	66	13	74		23	74	
4	84	66	14	74		24	78	
5	74	71	15	74		25	84	
6	74	58	16	74		26	84	
7	74	66	17	71		27	84	
8	74	58	18	71		28	78	
9	74	58	19	66		29	74	
10	74	58	20	74		30	74	
						31	74	

Daily gage height, in feet, of Wood River near Meeteetse, Wyo., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1		1.62	2.8	3.4	2.4	2.4	16	1.67	3.5	3.7	2.9	2.4	2.4
2		1.60	2.75	3.4	2.4	2.4	17	1.62	3.2	4.1	2.85	2.4	2.4
3		1.67	2.7	3.4	2.4	2.4	18	1.52	2.9	3.6	2.8	2.4	2.4
4		1.62	2.7	3.3	2.4	2.4	19	1.57	2.9	3.6	2.75	2.4	2.4
5		1.52	2.55	3.2	2.4	2.4	20	1.52	3.5		2.7	2.4	2.4
6		1.72	2.75	3.3	2.4	2.4	21	1.67	2.8		2.7	2.4	2.4
7		1.72	2.85	3.4	2.4	2.4	22	2.04	2.6		2.6	2.4	2.4
8		1.72	3.0	3.4	2.4	2.4	23	2.32	2.7		2.5	2.4	2.4
9		1.82	4.0	3.2	2.4	2.4	24	2.07	2.95	3.7	2.6	2.4	2.4
10	1.92	2.12	3.6	3.2	2.4	2.4	25	2.00	3.0	3.8	2.6	2.4	2.4
11	1.92	2.32	3.4	3.2	2.4	2.4	26	1.92	2.95	3.5	2.6	2.4	2.4
12	1.94	2.8	3.1	3.4	2.4	2.4	27	1.74	3.0	3.5	2.6	2.4	2.4
13	1.97	2.75	3.1	3.0	2.4	2.4	28	1.67	3.0	3.5	2.6	2.4	2.4
14	1.77	3.4	2.9	3.0	2.4	2.4	29	1.64	3.2	3.5	2.6	2.4	2.4
15	1.62	4.4	3.2	2.9	2.4	2.4	30	1.72	3.0	3.5	2.6	2.4	2.4
							31		2.9		2.45	2.4	

Monthly discharge of Wood River near Meeteetse, Wyo., for the period Oct. 1 to Nov. 11, 1916.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	84	66	75.4	4,640
November 1-11	71	52	62.3	1,360

SHELL CREEK AT SHELL, WYO.

LOCATION.—Near the western edge of sec. 26, T. 53 N., R. 91 W., 450 feet above head gate of Shell canal, three-quarters of a mile northeast of Shell, Big Horn County. Nearest tributary, Trapper Creek, enters a short distance above.

DRAINAGE AREA.—256 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 1, 1915, to September 30, 1917. From July 1, 1911, to October 31, 1914, station maintained by Wyoming Irrigation Co. and published in reports of State engineer.

GAGE.—Vertical staff on right bank 450 feet above canal head gate; read by J. G. Tatlock.

DISCHARGE MEASUREMENTS.—Made from suspension footbridge at gage or by wading at same section.

CHANNEL AND CONTROL.—Bed composed of gravel. Control just below gage at gravel bar which may shift during high water. Banks not subject to overflow.

EXTREMES OF DISCHARGE. Maximum stage recorded during year, 7.75 feet at 12.30 p. m., June 17 (discharge, 1,500 second-feet); minimum discharge probably occurred during winter.

ICE.—No information as records are discontinued during winter.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 8 second-feet from Shell Creek above the station, and 104 second-feet below.

REGULATION.—Flow controlled to a certain extent by storage of water in Adelaide reservoir, located on Shell Creek, 25 miles above Shell; capacity of reservoir 1,410 acre-feet. Water stored in reservoir beginning of high-water period and released in latter part of summer.

ACCURACY.—Stage-discharge relation not permanent. Rating curve well defined between 50 and 700 second-feet, but not well defined above 700 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except for period June 29 to September 30, when discharge was computed by indirect method for shifting control. Records excellent up to 700 second-feet; above this they are good.

Discharge measurements of Shell Creek at Shell, Wyo., during the year ending Sept. 30, 1917.

[Made by P. V. Hodges.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
May 11	4.17	71
June 28	6.15	657
Sept. 22	4.09	83

Daily discharge, in second-feet, of Shell Creek at Shell, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Apr.	May.	June.	July.	Aug.	Sept.
1	77	60	60	205	528	108	101
2	82	58	58	218	508	108	98
3	89	58	58	218	488	107	98
4	91	58	63	205	468	102	95
5	88	58	58	205	488	96	95
6	82	58	58	192	410	92	92
7	82	58	59	205	374	92	92
8	89	54	63	205	374	89	92
9	85	59	63	480	357	86	92
10	82	56	68	680	340	89	92
11	79	63	74	780	322	89	92
12	79	63	85	385	306	89	89
13	77	64	107	300	282	86	91
14	74	59	131	300	215	86	95
15	74	58	255	520	215	89	100
16	74	68	368	980	202	95	110
17	74	64	300	1,420	178	95	108
18	75	59	315	1,300	168	101	100
19	79	59	480	1,080	168	104	89
20	82	60	480	980	178	104	78
21	79	60	402	1,080	168	101	81
22	79	63	385	1,030	158	101	75
23	75	63	368	1,030	138	94	75
24	74	68	368	1,080	138	92	72
25	75	68	402	1,030	133	89	72
26	75	58	368	830	98	89	72
27	75	59	300	780	124	98	72
28	75	58	300	780	124	98	75
29	75	58	315	780	124	94	77
30	75	59	255	680	124	92	77
31	75	....	218	....	124	92	....

Monthly discharge of Shell Creek at Shell, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	91	74	78.9	4,850
April	68	54	60.3	3,590
May	480	58	222	13,600
June	1,420	192	665	39,600
July	528	98	259	15,900
August	108	86	95.1	5,850
September	110	72	88.2	5,250

SHOSHONE RIVER NEAR ISHAWOOA, WYO.

LOCATION.—On line between secs. 26 and 27, T. 51 N., R. 104 W., at Coe's private bridge, 1½ miles northeast of Ishawooa, Park County. Nearest tributary, Belknap Creek, enters at Ishawooa.

DRAINAGE AREA.—532 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 7, 1915, to September 30, 1917.

GAGE.—Vertical staff on first right downstream piling of bridge; read by Miss Ina Spaulding and Loyd Spaulding.

DISCHARGE MEASUREMENTS.—Made from five-span pile bent bridge or by wading.

CHANNEL AND CONTROL.—Channel composed of boulders, control not well defined; shifts during high water. Right bank not subject to overflow; left bank will be overflowed at high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.0 feet at 8.15 p. m. July 5 (discharge, 4,420 second-feet); minimum discharge probably occurred during winter.

ICE.—No information, as records are discontinued.

DIVERSIONS.—Prior to December 31, 1916, there were approved diversions of 26 second-feet from Shoshone River above the station and 40 second-feet above Shoshone reservoir.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Rating curve fairly well defined between 200 and 4,400 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table, except for period June 24 to September 30, when discharge was computed by indirect method for shifting control. Records good, except during high stages when they are only fair, owing to wave action at gage, and diurnal fluctuation.

Discharge measurements of Shoshone River near Ishawooa, Wyo., during the year ending Sept. 30, 1917.

[Made by P. V. Hodges.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
May 13	2.59	778	Aug. 2	3.20	973
June 22	5.70	4,130	Sept. 24	1.80	258

Daily discharge, in second-feet, of Shoshone River near Ishawooa, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	235	200	....	107	669	3,300	895	378
2	272	200	....	107	860	3,030	965	334
3	312	200	....	122	731	3,580	895	334
4	235	200	....	122	669	4,280	895	334
5	272	200	....	136	554	4,420	763	334
6	292	200	....	184	669	3,580	700	378
7	272	200	....	200	669	3,580	700	334
8	272	184	....	218	795	3,930	640	312
9	254	167	....	218	2,530	3,930	640	292
10	235	167	....	312	2,410	3,510	582	292
11	254	167	....	501	554	3,230	610	292
12	254	....	....	731	1,150	3,650	610	292
13	235	....	....	731	501	3,230	610	292
14	235	....	....	1,470	1,070	3,160	554	292
15	235	....	....	2,410	1,850	2,180	501	292
16	235	....	....	1,560	3,160	2,180	501	272
17	235	....	....	1,070	3,440	2,290	501	292
18	235	....	....	1,000	4,140	2,180	554	254
19	235	....	....	1,960	3,720	2,410	554	254
20	218	....	....	582	4,000	2,350	450	254
21	235	....	....	610	3,860	2,120	450	254
22	235	....	136	610	4,140	2,020	450	254
23	235	....	152	860	4,000	2,590	450	254
24	235	....	167	1,000	4,210	2,020	401	254
25	235	....	152	795	3,790	2,020	450	254
26	218	....	167	1,000	3,650	1,650	401	254
27	235	....	136	731	3,650	1,850	501	254
28	235	....	136	795	3,930	1,750	501	254
29	200	....	107	860	4,210	860	501	254
30	200	....	122	860	3,510	860	501	254
31	200	....	....	731	....	930	401	....

Monthly discharge of Shoshone River near Ishawooa, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	312	200	241	14,800
November 1-11	200	167	190	4,150
April 22-30	167	107	142	2,540
May	2,410	107	729	44,800
June	4,210	501	2,440	145,000
July	4,420	860	2,670	164,000
August	965	401	585	36,000
September	378	254	288	17,100

SOAP CREEK NEAR ST. XAVIER, MONT.

LOCATION.—In sec. 20, T. 5 S., R. 32 E., at Henry Reed's ranch, 9 miles south of St. Xavier and 1 mile above mouth of stream, in Big Horn County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—September 11, 1911, to September 30, 1917. April 25, 1914, to June 12, 1915, at Frank Annerer's ranch, half a mile above present site; September 11, 1911, to November 30, 1913, in W. ½ NW. ¼ sec. 2, T. 6 S., R. 32 E., a quarter of a mile above headworks of Soap Creek ditch.

GAGE.—Overhanging chain gage on right bank opposite Henry Reed's house; read by Henry Reed. Original gage, in use September 11, 1911, to November 30, 1913, was overhanging chain gage about a quarter of a mile above headworks of Soap Creek ditch; gage used April 25, 1914, to June 12, 1915, a chain gage on footbridge near Frank Annerer's house, a quarter of a mile above present site.

DISCHARGE MEASUREMENTS.—Made by wading or from highway bridge 1 mile upstream from gage.

CHANNEL AND CONTROL.—Bed of stream at principal control is composed of gravel and silt; shifts slightly. Stage-discharge relation affected at times by growth of aquatic plants in channel.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.69 feet March 25, determined by level from stake set by observer at water level during heavy ice jam (discharge not computed); minimum stage recorded, 2.80 feet August 13 (discharge, 11 second-feet).

1911–1917: Maximum stage recorded, 12.8 feet May 11, 1914, determined by leveling from flood marks (discharge, determined from extension of rating curve, 438 second-feet); minimum stage recorded, 2.1 feet September 10, 1914 (discharge, 1 second-foot).

ICE.—Stage-discharge relation seriously affected by ice November 11 to March 24. Flow not computed; gage heights were obtained November 12 to December 31.

DIVERSIONS.—Soap Creek ditch diverts above station during summer for irrigation.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; seriously affected by ice during winter and by shifting control May 30 to September 30. Rating curve used October 1 to November 11 poorly defined; curve used April 1 to May 29 fairly well defined; indirect method for shifting control used May 30 to September 30. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records October 1 to November 11 are poor; April 1 to September 30 fair.

Discharge measurements of Soap Creek near St. Xavier, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
May 4	2.94	20.2
June 22	3.35	33.4
Aug. 11	2.85	11.7

Daily discharge, in second-feet, of Soap Creek near St. Xavier, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	22	21	108	27	225	17	13	15
2	22	21	85	26	91	16	13	16
3	22	21	87	22	56	16	12	17
4	22	21	107	21	64	16	14	17
5	22	22	190	66	204	16	14	17
6	22	22	249	204	252	16	12	17
7	22	22	69	164	127	17	12	17
8	25	22	151	40	100	17	13	17
9	26	22	181	35	90	16	13	17
10	22	23	140	37	94	16	12	17
11	23	21	86	39	123	16	12	18
12	22	....	82	40	81	15	11	18
13	22	....	62	46	74	15	11	18
14	22	....	57	56	60	15	12	18
15	22	....	68	65	57	16	13	19
16	22	....	55	72	54	16	12	21
17	21	....	48	66	48	16	13	23
18	22	....	37	44	46	16	13	22
19	25	....	37	39	44	16	14	23
20	26	....	26	38	44	15	14	21
21	26	....	23	42	44	15	14	21
22	26	....	32	38	34	17	14	22
23	25	....	31	30	23	17	14	21
24	23	....	37	30	27	14	14	23
25	22	....	29	29	20	14	14	23
26	22	....	28	28	24	14	14	24
27	22	....	35	30	24	14	14	24
28	23	....	24	26	24	13	14	23
29	23	....	26	37	22	13	15	24
30	22	....	26	249	22	12	15	24
31	22	....	....	226	....	13	15	....

Monthly discharge of Soap Creek near St. Xavier, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	26	21	22.9	1,410
November 1-11	23	21	221.6	471
April	249	23	73.9	4,400
May	249	21	61.7	3,790
June	252	20	73.3	4,360
July	17	12	15.3	941
August	15	11	13.2	812
September	24	15	19.9	1,180

ROTTENGRASS CREEK NEAR ST. XAVIER, MONT.

LOCATION.—In NW. ¼ sec. 6, T. 5 S., R. 23 E., a quarter of a mile above crossing of Big Horn canal, on Crow Indian Reservation, 4 miles south of St. Xavier, in Big Horn County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—September 9, 1911, to September 30, 1917.

GAGE.—Overhanging chain on left bank a quarter of a mile above crossing of Big Horn canal; read by Loren S. Stanley.

DISCHARGE MEASUREMENTS.—Made from footbridge 500 feet above gage or by wading.

CHANNEL AND CONTROL.—Bed of stream gravel and silt; shifts. Banks above and below gage high and steep; not subject to overflow below gage height 11 feet (discharge, about 400 second-feet).

EXTREMES OF DISCHARGE.—Maximum stage during year, 11.3 feet at 5.30 p. m. March 30 (discharge, from extension of rating curve, 500 second-feet); minimum stage recorded, 2.90 feet 6 p. m. August 16 (discharge, 2.5 second-feet).

1911–1917: Maximum stage recorded, 11.3 feet March 30, 1917 (discharge, 500 second-feet); minimum stage recorded, 2.3 feet September 27, 1911 (discharge 0.3 second-foot).

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued November 10 to March 30.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed by high water in March. Rating curve used October 1 to November 9 well defined below 100 second-feet; curve used March 30 to September 30 well defined below 60 second-feet. Gage read to half-tenths twice daily; read occasionally to quarter-tenths. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Rottengrass Creek near St. Xavier, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
May 4	4.12	31.6
June 22	4.59	46.2
Aug. 11	3.04	4.8

Daily discharge, in second-feet, of Rottengrass Creek near St. Xavier, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	8.0	8.0		139	36	200	21	5.8	3.2
2	8.0	8.0		133	34	270	20	5.8	3.2
3	8.0	8.0		133	30	228	19	5.8	3.2
4	7.0	8.0		139	32	228	16	5.8	3.2
5	8.0	8.0		284	37	228	14	5.8	3.2
6	8.0	8.0		284	82	181	14	5.8	3.2
7	8.0	8.0		163	103	151	14	5.8	3.2
8	7.5	8.0		163	103	92	14	5.8	3.2
9	8.0	8.0		181	77	82	14	5.8	3.2
10	8.0			163	55	109	14	5.8	3.2
11	7.5			127	47	115	14	5.4	3.2
12	7.5			92	47	109	14	4.0	3.2
13	8.0			82	47	87	14	4.0	2.8
14	8.0			72	51	87	14	4.0	4.0
15	8.0			72	72	63	14	3.2	4.0
16	8.2			55	97	63	14	2.5	4.8
17	8.0			51	169	59	14	4.0	5.0
18	8.2			36	175	63	14	4.0	5.0
19	8.2			36	145	59	14	3.7	4.5
20	8.2			31	151	55	14	3.2	4.8
21	8.5			28	82	59	14	3.2	5.0
22	9.5			34	82	51	12	2.8	5.0
23	10			34	77	43	12	2.5	4.8
24	10			37	51	42	9	2.5	5.0
25	10			37	63	43	13	2.5	4.0
26	10			34	63	38	11	3.2	4.0
27	10			40	59	31	9.6	3.2	5.0
28	9.0			40	63	25	6.6	3.2	5.0
29	9.0			40	72	24	5.6	3.2	5.0
30	9.0		496	34	115	24	5.6	3.2	5.0
31	9.0		352		175		5.6	3.2	

Monthly discharge of Rottengrass Creek near St. Xavier, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	10	7.5	8.46	520
November 1-9	8.0	8.0	8.00	143
March 30-31				1,690
April	284	28	93.1	5,540
May	175	30	80.4	4,940
June	270	24	97.0	5,770
July	21	5.6	13.1	806
August	5.8	2.5	4.15	255
September	5.0	2.8	4.05	241

LITTLE HORN RIVER NEAR WYOLA, MONT.

Location.—In W. ½ SW. ¼ sec. 28, T. 2 S., R. 35 E., a quarter of a mile below proposed headworks of Little Big Horn canal No. 3, 16 miles above Lodgegrass Creek, and 4 miles southwest of Wyola, in Big Horn County.

Drainage area.—260 square miles.

Records available.—September 7, 1911, to September 30, 1917.

Gage.—Overhanging chain gage on right bank; read by Ida M. Shipman and Granville Collins.

Discharge measurements.—Made from cable 75 feet below gage or by wading near cable.

Channel and control.—Composed of boulders and gravel; shifts occasionally at high stage. Left bank high and not subject to overflow; right bank high but subject to overflow 100 feet below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.1 feet at 7 a. m. June 22 (discharge, 1,580 second-feet); minimum stage, 4.20 feet March 15–20 and 22–24 (discharge, 82 second-feet).

1912–1917: Maximum stage recorded, 7.1 feet June 22, 1917 (discharge, 1,580 second-feet); minimum stage, 4.2 feet April 10 and 12, 1915 (discharge, 32 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued December 10 to March 11.

DIVERSIONS.—Small amount diverted for irrigation.

REGULATION.—None.

ACCURACY.—Stage-discharge relations not permanent; affected by shifting control and by ice. Rating curve used October 1 to April 15 well defined below 500 second-feet; shifting-control method used April 16 to September 30. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records fair.

Discharge measurements of Little Horn River near Wyola, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 2	4.31	99	June 21	6.15	958
May 3	4.32	97	Aug. 11	4.53	162

Daily discharge, in second-feet, of Little Horn River near Wyola, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	120	110	106		131	100	396	702	166	124
2	120	110	104		120	99	373	675	166	124
3	124	116	104		120	98	331	648	166	124
4	131	116	108		131	112	373	648	180	122
5	124	116	104		131	180	568	621	180	122
6	124	116	110		131	144	373	568	180	122
7	131	114	110		120	114	373	568	164	120
8	124	110	111		120	104	373	516	161	120
9	124	110	112		129	112	516	491	161	120
10	120	110			133	106	785	466	161	118
11	120	110		120	131	118	730	418	159	118
12	124	112		100	124	140	648	373	159	118
13	120	110		100	122	156	542	373	159	116
14	116	114		91	120	208	516	274	156	116
15	120	110		82	120	274	648	193	156	116
16	120	110		82	120	396	785	161	156	120
17	120	112		82	114	373	950	149	152	118
18	124	112		82	108	396	1,250	161	142	114
19	120	108		82	98	396	1,250	193	142	114
20	120	108		82	102	442	1,190	223	135	114
21	122	110		91	106	418	1,070	208	131	112
22	120	110		82	106	331	1,510	193	131	112
23	116	108		82	96	312	1,130	193	129	112
24	114	106		82	114	352	1,070	193	129	112
25	114	108		91	104	352	1,190	208	129	100
26	116	108		91	95	373	1,010	193	129	91
27	120	110		100	108	331	840	193	127	91
28	122	110		120	102	352	621	193	127	91
29	120	110		223	102	442	1,070	180	127	89
30	116	108		193	101	542	950	166	127	89
31	110			142		418		166	124	

NOTE.—Discharge interpolated Dec. 8, Mar. 18, Apr. 1, 13, 15, 25, 29, 30, May 1 and 2.

Monthly discharge of Little Horn River near Wyola, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	131	110	121	7,440
November	116	106	111	6,600
December 1-9	112	104	108	1,930
March 11-31	223	82	105	4,370
April	133	95	115	6,840
May	542	98	267	16,400
June	1,510	331	781	46,500
July	702	149	339	20,800
August	180	124	148	9,100
September	124	89	113	6,720

LITTLE HORN RIVER NEAR CROW AGENCY, MONT.

LOCATION.—In W. ½ sec. 18, T. 3 S., R. 35 E., at Chicago, Burlington & Quincy Railroad bridge 2 miles south of Crow Agency, in Big Horn County, 14 miles above junction with Big Horn River.

DRAINAGE AREA.—1,190 square miles.

RECORDS AVAILABLE.—September 7, 1911, to September 30, 1917; March 24, 1905, to June 30, 1906, for station at Crow Agency, 2 miles below present station; Crow Agency ditch diverts water between the stations.

GAGE.—Stevens water-stage recorder on right bank 40 feet below railway bridge set to same datum as chain gage; chain gage on downstream side of railway bridge 1912 to 1916. Records for 1911 were obtained from staff on bridge pier near left bank; gages at same datum. Records 1905–6 obtained from chain gage on upstream side of railroad bridge at Crow Agency.

DISCHARGE MEASUREMENTS.—Made from upstream side of highway bridge 200 feet below gage or by wading.

CHANNEL AND CONTROL.—Bed of stream composed of gravel; slightly shifting. Banks high; not subject to overflow below gage height, about 14 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.8 feet at 8 a. m. April 6 (discharge, 3,930 second-feet); minimum stage, 4.40 feet October 1–7, November 1, August 29 to September 9, September 14, 22–30 (discharge, 129 second-feet).

1905 and 1912–1917: Maximum stage recorded, 10.8 feet April 6, 1917 (discharge, 3,930 second-feet); minimum stage, 1.8 September 25–29, 1905 (discharge, 60 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

DIVERSIONS.—Several small diversions for irrigation from main stream and tributaries above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 150 and 4,000 second-feet. Gage read to half-tenths once daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Little Horn River near Crow Agency, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Oct. 11	4.52	168	May 27	5.75	758
Dec. 4	4.58	178	June 22	6.85	1,410
Apr. 6	10.35	[a] 3,530	Aug. 10	4.61	196
May 5	5.15	398			

[a] Velocity determined by surface method, using a coefficient of 0.90 to obtain mean velocity. Stage fell at rate of 0.3 foot per hour during measurement.

Daily discharge, in second-feet, of Little Big Horn River near Crow Agency, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	129	171	....	1,180	940	820	186	129
2	129	171	....	1,150	820	791	186	129
3	129	171	....	1,150	880	791	186	129
4	129	156	....	1,150	820	762	156	129
5	129	156	....	436	676	704	156	129
6	129	156	3,600	540	940	733	156	129
7	129	142	2,920	514	880	648	156	129
8	156	142	2,240	488	850	621	156	129
9	156	142	2,370	436	704	594	156	129
10	142	142	2,470	386	880	594	186	142
11	156	129	2,180	339	1,180	567	186	142
12	156	....	2,040	339	1,150	540	186	142
13	156	....	1,780	436	1,120	488	156	142
14	142	....	1,660	436	1,060	436	156	129
15	156	....	1,600	488	1,060	411	156	142
16	142	....	1,570	567	1,030	386	156	156
17	142	....	1,540	567	1,030	362	156	156
18	142	....	1,480	648	1,180	339	156	156
19	142	....	1,480	648	1,420	317	156	156
20	156	....	1,480	704	1,360	317	156	142
21	171	....	1,480	704	1,330	296	156	142
22	171	....	1,420	676	1,330	275	156	129
23	186	....	1,420	648	1,480	275	156	129
24	186	....	1,390	594	1,390	255	156	129
25	186	....	1,360	594	1,300	237	156	129
26	186	....	1,330	621	1,240	237	156	129
27	186	....	1,300	676	1,210	219	156	129
28	186	....	1,240	621	1,120	202	156	129
29	186	....	1,240	648	1,090	202	129	129
30	186	....	1,210	880	1,060	186	129	129
31	186	....	....	1,300	....	186	129	....

Monthly discharge of Little Horn River near Crow Agency, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	186	129	157	9,650
November 1-11	171	129	153	3,340
April 6-30	3,600	1,210	1,750	86,800
May	1,300	339	663	40,800
June	1,480	676	1,080	64,300
July	820	186	445	27,400
August	186	129	159	9,780
September	156	129	136	8,090

LODGEGRASS CREEK AT LODGEGRASS, MONT.

LOCATION.—In S. ½ sec. 13, T. 6 S., R. 35 E., 600 feet above Chicago, Burlington & Quincy Railroad bridge and a quarter of a mile south of Lodgegrass, on Crow Indian Reservation, in Big Horn County.

DRAINAGE AREA.—Not measured (142 square miles at old site, 6 miles upstream).

RECORDS AVAILABLE.—March 24, 1916, to September 30, 1917, at present site; September 9, 1911, to December 28, 1915, at old site 6 miles above in SW. ¼ sec. 29, T. 6 S., R. 35 E., a quarter of a mile above Lodgegrass ditch.

GAGE.—Overhanging wire gage on left bank; at old site, an overhanging chain gage at different datum.

DISCHARGE MEASUREMENTS.—Made from the railway bridge or by wading.

CHANNEL AND CONTROL.—Control is an outcrop of sandstone overlain by boulders and gravel; boulders and gravel likely to shift.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.05 feet March 31, when stage-discharge relation was affected by ice (discharge not computed); minimum stage, 1.85 feet October 1, 2, and 15 (discharge, 14 second-feet).

1911–1917: Maximum stage, 7.0 feet June 13, 1915 (discharge, 695 second-feet), minimum stage, 1.80 feet September 9 and 13, 1916 (discharge, 11 second-feet).

ICE.—Stage-discharge relation seriously affected by ice November 17 to March 31; flow not determined. No records December 23 to March 29.

DIVERSIONS.—Lodgegrass ditch diverts water for irrigation 6 miles above present site. Old station was a quarter of a mile above headworks of this ditch; hence flow during irrigation season is not comparable to that at present site.

REGULATION.—None.

ACCURACY.—Daily gage heights taken from observer's readings to nearest quarter-tenth once daily. Two readings were taken during rapid change in stage. Daily discharge obtained by applying daily gage heights to rating table, October 1 to November 17, April 16 to July 28, and August 10 to September 20. Discharge obtained April 1–15 and July 28 to August 9 by shifting-control method; records fair. Curve used October 1 to November 17 and April 16 to July 28 fairly well defined between 15 and 400 second-feet; records good.

Discharge measurements of Lodgegrass Creek at Lodgegrass, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 2	a 2.23	27.2	May 3	2.39	62	Aug. 10	2.17	29.1
Apr. 5	3.65	374	June 21	3.90	378			

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Lodgegrass Creek at Lodgegrass, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	11	22	503	55	296	290	48	21
2	14	20	235	58	187	237	45	21
3	18	20	146	63	170	225	41	21
4	22	20	131	63	154	218	40	21
5	22	20	350	90	187	213	37	18
6	20	20	373	237	394	209	36	18
7	20	22	148	166	180	195	33	18
8	22	20	387	94	166	187	32	18
9	22	22	600	80	166	174	31	18
10	22	24	346	74	187	170	30	18
11	20	26	182	74	318	160	30	18
12	18	26	161	77	318	136	30	16
13	18	26	133	87	258	108	30	16
14	17	22	116	98	202	104	27	16
15	14	18	156	116	180	101	27	21
16	18	20	87	132	202	90	27	30
17	18	20	87	166	268	87	21	30
18	20	....	68	150	347	80	24	30
19	20	....	63	124	428	63	24	72
20	20	....	63	141	378	63	24	27
21	20	....	72	154	381	63	22	24
22	24	....	74	146	353	63	22	22
23	26	....	74	124	394	63	22	21
24	22	....	90	113	394	63	22	21
25	20	....	74	113	394	63	21	21
26	22	....	63	116	418	63	21	22
27	24	....	74	141	332	63	21	24
28	26	....	63	132	318	60	21	24
29	26	....	74	160	310	59	21	24
30	24	....	58	202	318	55	21	22
31	22	....	....	250	....	51	21	....

Monthly discharge of Lodgegrass Creek at Lodgegrass, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	26	14	20.5	1,260
November 1-17	26	18	21.6	728
April	600	58	168	10,000
May	250	55	122	7,500
June	428	154	287	17,100
July	290	51	122	7,500
August	48	21	28.2	1,730
September	30	16	21.6	1,290

TONGUE RIVER AT CARNEYVILLE, WYO.

LOCATION.—In sec. 20, T. 57 N., R. 84 W., at highway bridge at Carneyville, Sheridan County. Nearest important tributary, Goose Creek, enters 3 miles below.

DRAINAGE AREA.—495 square miles (measured on base map of Wyoming; scale, 1: 500,000).

RECORDS AVAILABLE.—May 25, 1911, to October 31, 1912; April 4, 1915, to June 30, 1917, when station was discontinued.

GAGE.—Chain gage on downstream side of bridge; read by Walter Bone.

DISCHARGE MEASUREMENTS.—Made from two-span bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and small boulders; shifts; no well defined control. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.3 feet at 11.30 a. m., June 18 (discharge, 2,690 second-feet); minimum stage probably occurred during winter.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 188 second-feet from Tongue River above station and 33 second-feet below.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by ice during winter. Rating curve used October 1 to November 12 is fairly well defined between 100 and 1,400 second-feet and curve used June 15–30 is well defined between 100 and 2,800 second-feet; shifting-control method used April 8 to June 14. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Tongue River at Carneyville, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Apr. 26	Robert Follansbee	3.34	151
June 18	P. V. Hodges	7.27	2,660

Daily discharge, in second-feet, of Tongue River at Carneyville, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	Day.	Oct.	Nov.	Apr.	May.	June.
1	120	110	....	135	986	16	112	....	152	1,080	1,880
2	130	120	....	160	1,050	17	124	....	152	1,020	2,280
3	138	133	....	142	992	18	130	....	142	962	2,600
4	138	128	....	152	1,110	19	105	....	128	1,080	2,280
5	138	116	....	264	1,170	20	94	....	126	1,150	2,180
6	124	108	....	202	992	21	140	....	133	1,150	2,100
7	124	112	....	174	998	22	198	....	126	917	2,180
8	133	91	730	174	998	23	128	....	158	974	2,100
9	138	94	675	174	1,240	24	105	....	163	1,030	2,020
10	128	140	542	177	2,160	25	124	....	163	974	1,940
11	124	118	329	206	2,250	26	138	....	163	1,100	1,710
12	120	88	283	291	1,630	27	138	....	140	980	1,640
13	124	....	244	333	1,300	28	133	....	138	1,040	1,430
14	116	....	226	573	1,300	29	140	....	147	1,160	1,430
15	124	....	193	741	1,500	30	124	....	133	1,990	1,310
						31	124	....	....	1,230	....

Monthly discharge of Tongue River at Carneyville, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	198	94	128	7,870
November 1-12	140	88	113	2,690
April 8-30	730	126	234	10,700
May	1,990	135	700	43,000
June	2,600	986	1,620	96,400

POWDER RIVER NEAR ARVADA, WYO.

LOCATION.—Near line between Tps. 56 and 57 N., R. 76 W., at State bridge 17 miles north of Arvada, Sheridan County. Nearest tributary, Clear Creek, enters 200 yards below.

DRAINAGE AREA.—6,580 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—September 1, 1915, to September 30, 1917.

GAGE.—Chain gage on upstream guard-rail of bridge, since May 4, 1916; read by John Watt. Prior to that date, gage was inclined staff 1 mile upstream at K ranch.

DISCHARGE MEASUREMENTS.—Made from two-span highway bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of silt and gravel. Control just above mouth of Clear Creek. During high water there may be backwater from Clear Creek as there is only 2 feet fall between station and creek.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8 feet at 1.30 p. m. May 22 (discharge, 8,780 second-feet); minimum stage recorded, 475 feet on August 27 (discharge, 6 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; observation discontinued during winter.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 9 second-feet from Powder River above station and none below.

REGULATION.—None.

ACCURACY.—Stage-discharge relation fairly permanent, except for a short time during high water when it was affected by backwater from Clear Creek. Affected by ice during winter. Rating curve well defined below 2,000 second-feet but poorly defined above. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Owing to flashy character of stream, one gage height per day will not give true mean stage for the day. Records fair.

Discharge measurements of Powder River near Arvada, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
May 1	Robert Follansbee	4.30	403
June 14	P. V. Hodges	5.48	2,110
July 29	.....do	3.44	81

Daily discharge, in second-feet, of Powder River near Arvada, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	34	175		485		975	40	87
2	37	192		390		692	27	87
3	58	192		740		636	18	78
4	55	182		740		620	18	51
5	58	175		795		602	27	51
6	55	159		645		522	100	44
7	61	159		645		452	92	42
8	64	159		1,680	1,280	421	84	38
9	89	172		850	3,180	390	38	38
10	246	175		740	1,910	378	38	38
11	295			645	2,660	344	38	37
12	265			645	3,180	305	37	36
13	210			485	2,660	255	37	34
14	189			485	2,160	305	25	33
15	98			560	1,280	214	22	32
16	102			2,410	1,470	175	22	31
17	107			3,700	1,470	159	18	42
18	107			4,220	1,680	159	18	47
19	116			4,740	2,410	143	18	68
20	143			3,960	2,410	130	16	55
21	149			3,700	2,410	130	11	54
22	159			8,780	2,410	116	11	55
23	169			5,000	2,410	111	38	54
24	175			3,180	2,160	84	24	52
25	175			2,660	2,160	130	18	48
26	169			3,440	2,160	104	12	48
27	175			3,180	1,910	66	6	48
28	210		522	3,180	1,910	74	22	44
29	206		522	2,660	1,470	84	27	44
30	182		522	5,000	1,050	51	22	46
31	182					48	22	

NOTE.—Discharge estimated July 8, Aug. 7, 11, 12, 25, 26, and Sept. 30. Rating table applied indirectly June 17-23, on account of backwater from Clear Creek.

Monthly discharge of Powder River near Arvada, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	295	34	140	8,610
November 1-10	192	159	174	3,450
May 1-30	8,780	390	2,340	139,000
June 8-30	3,180	1,050	2,080	94,900
July	975	48	286	17,600
August	100	6	30.5	1,880
September	87	31	48.7	2,900

CLEAR CREEK NEAR BUFFALO, WYO.

LOCATION.—In sec. 6, T. 50 N., R. 82 W., just above power house of Buffalo Manufacturing Co., 4 miles west of Buffalo, in Johnson County.

DRAINAGE AREA.—120 square miles (measured on topographic map).

Records available.—June 16 to September 30, 1917. From May 2, 1896, to February 28, 1900, station maintained at measuring flume 1 mile upstream. Flow at two points comparable. From October 24, 1902, to December 31, 1904, and May 8, 1911, to June 11, 1912, a station was maintained at highway bridge in Buffalo. Flow not comparable, as several ditches divert water between.

Gage.—Chain gage at left bank 300 feet above power house.

Discharge measurements.—Made from cable located 50 feet upstream from gage. Low-water measurements made by wading opposite power house.

Channel and control.—Channel composed of large boulders; control at large boulders 10 feet downstream; permanent during 1917. Banks low, but not subject to overflow because of small range of stage.

Ice.—Stage-discharge relation seriously affected by ice; records discontinued.

Extremes of discharge.—Maximum stage recorded 4.2 feet at 6.30 a. m. June 18 (discharge, 1,120 second-feet); minimum discharge occurred during winter.

Diversions.—Pipe line of Buffalo Manufacturing Co. diverts water from Clear Creek 1½ miles upstream. A separate record of flow through pipe line is kept and flow added to that at gaging station to give total flow of creek. Four lakes and French Creek canal had adjudicated decrees for diversion of 25 second-feet from North Fork into French Creek prior to December 31, 1916. During 1917, 10,360 acre-feet were diverted between June 10 and September 30. North Fork and French Creek canal diverted 1,230 acre-feet between June 10 and July 21. Below there are adjudicated decrees for diversion of 428 second-feet.

Regulation.—Alternate melting and freezing of snow in mountains during spring causes diurnal fluctuation in flow. No artificial regulation.

Accuracy.—Stage-discharge relation practically permanent; affected by ice during winter. Rating curve well defined between 10 and 800 second-feet. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Clear Creek near Buffalo, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	Sec.-ft.			Feet.	Sec.-ft.
Apr. 29	Robert Follansbee	0.86	5.4	Aug. 9	Mull	1.60	61.3
June 16	Hodges and Beebe	3.18	600	Sept. 28	P. V. Hodges	1.28	26.2
July 31	.....do	1.84	107				

Daily discharge, in second-feet, of Clear Creek near Buffalo, Wyo., for the year ending Sept. 30, 1917.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1		433	98	57	16	637	208	44	33
2		369	89	44	17	900	192	57	28
3		476	72	38	18	1,040	208	80	28
4		476	80	38	19	750	225	134	28
5		632	80	38	20	825	225	162	28
6		542	80	38	21	700	208	147	28
7		520	64	38	22	900	192	98	33
8		542	64	38	23	775	192	80	26
9		565	64	28	24	775	192	72	28
10		498	64	28	25	875	162	64	28
11		454	57	28	26	700	162	64	28
12		348	64	28	27	725	162	64	27
13		329	50	28	28	700	177	64	26
14		293	50	33	29	750	162	64	23
15		242	50	38	30	700	134	57	23
					31		109	50	

Note.—The above table does not include water diverted by pipe line of the Buffalo Manufacturing Co.

Monthly discharge of Clear Creek near Buffalo, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
June 16-30	1,040	637	783	23,300
July	632	109	311	19,100
August	162	44	75.1	4,620
September	57	23	31.9	1,900
The period				48,900

NOTE.—The above table does not include water diverted by the pipe line of the Buffalo Manufacturing Co.

Combined monthly discharge of Clear Creek and pipe line of Buffalo Manufacturing Co., near Buffalo, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
June 16-30	1,050	649	795	23,700
July	644	121	323	19,900
August	174	56	87.1	5,360
September	69	34	43.3	2,580
The period				51,500

CLEAR CREEK NEAR ARVADA, WYO.

LOCATION.—In sec. 36, T. 57 N., R. 77 W., at Sorenson's ranch, 1½ miles above mouth of creek and 16 miles north of Arvada, Sheridan County. No tributary between station and mouth of creek.

DRAINAGE AREA.—1,110 square miles (measured on base map of Wyoming; scale 1:500,000).

RECORDS AVAILABLE.—August 8, 1915, to September 30, 1917.

GAGE.—Chain gage on right bank a quarter mile below diversion dam at Sorenson's ranch; read by Miss Carrier Sorenson.

DISCHARGE MEASUREMENTS.—Made from cable 50 feet below gage or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel. Multiple control consisting of two rock dikes across the river 150 feet apart; upper dike 100 feet below gage acts as low-water control. At high water, lower dike is control. At low stages silt collects in the crevices of the rock dike changing the stage-discharge relation. Banks not subject to overflow. Stage of zero flow, 3.8 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.2 feet at 7 p.m. June 18 (discharge, 2,630 second-feet); minimum discharge probably occurred during winter.

ICE.—Stage-discharge relation seriously affected by ice; observation discontinued during winter.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 428 second-feet from Clear Creek.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by ice during winter. Rating curve well defined between 20 and 2,800 second-feet. Gage read to hundredths once daily except during flood stages when it was read twice daily. Daily discharge ascertained by applying to rating table the daily gage height, or the mean of two daily gage heights. Records good.

Discharge measurements of Clear Creek near Arvada, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 2	Robert Follansbee....	5.02	208	June 19	P. V. Hodges.........	8.16	2,570
June 14	P. V. Hodges..........	6.68	1,140	July 29	.....do.................	4.98	184

Daily discharge, in second-feet, of Clear Creek near Arvada, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	16	39	....	195	1,400	1,080	65	56
2	17	34	....	210	1,320	720	57	77
3	17	34	....	242	1,240	590	44	75
4	18	34	....	225	1,320	590	34	75
5	19	34	....	225	1,320	590	34	53
6	19	34	....	225	1,160	560	32	53
7	20	34	....	225	1,000	530	73	53
8	18	34	....	260	930	545	30	52
9	21	34	....	260	1,080	560	20	52
10	21	34	....	260	1,680	590	15	48
11	22	34	....	260	2,180	620	16	47
12	20	....	....	320	1,880	505	16	49
13	21	....	....	430	1,400	380	17	49
14	21	....	....	530	1,160	300	18	49
15	20	....	....	1,000	1,160	242	20	48
16	16	....	340	825	1,400	195	20	48
17	18	....	260	1,160	2,080	152	23	56
18	20	....	260	1,160	2,620	106	23	53
19	20	....	280	1,000	2,620	88	26	53
20	21	....	225	1,240	2,180	54	26	52
21	21	....	225	2,180	2,180	42	28	52
22	20	....	242	1,490	2,180	54	82	50
23	28	....	242	1,240	2,080	62	114	53
24	31	....	260	1,240	1,880	54	92	53
25	26	....	300	1,490	1,780	53	50	52
26	25	....	280	1,780	1,780	54	58	52
27	34	....	260	1,490	1,680	54	65	50
28	34	....	242	1,400	1,490	44	60	57
29	44	....	210	1,400	1,320	225	57	57
30	39	....	195	2,290	1,240	73	50	60
31	34	....	....	1,780	....	70	57	....

NOTE.—Oct. 1 to Nov. 11, Sept. 1 to 30 discharge computed by indirect method for shifting control. July 8, Aug. 11-12, 26 no gage readings. Discharge interpolated.

Monthly discharge of Clear Creek near Arvada, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	44	16	23.3	1,430
November 1-11	39	34	34.5	753
Apr. 16-30	340	195	255	7,590
May	2,290	195	904	55,600
June	2,620	930	1,620	96,400
July	1,080	42	316	19,400
August	114	15	42.6	2,620
September	77	47	54.5	3,240

PINEY CREEK AT KEARNEY, WYO.

LOCATION.—In sec. 26, T. 53 N., R. 83 W., at highway bridge 300 yards south of Kearney, Johnson County.

DRAINAGE AREA.—117 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—September 6, 1902, to June 30, 1906; May 13, 1911, to October 31, 1912; April 24, 1915, to July 31, 1917, when station was discontinued.

GAGE.—Chain gage on downstream side of bridge; read by Mrs. Lena Noyce. Gage used 1902–1916 was at same site but referred to different datum.

DISCHARGE MEASUREMENTS.—Made from single-span bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and small boulders; control 100 feet downstream at well-defined rapids, which shifted slightly during 1917. At high water there is flow through a small channel at the left bank which diverts water from Piney Creek some distance above the station. Flow through this channel begins at stage of approximately 5 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.7 feet at 6 p. m June 17 (discharge, 1,220 second-feet); minimum discharge probably occurred during winter.

ICE.—Stage-discharge relation affected by ice; observations discontinued during winter.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 278 second-feet from Piney Creek above station and 74 second-feet below.

REGULATION.—None.

ACCURACY.—Stage-discharge relation slightly shifting; affected by ice during winter. Rating curve well defined between 10 and 1,000 second-feet. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily heights to rating table, except for period June 8 to July 31, when discharge was computed by indirect method for shifting control. Records excellent.

Discharge measurements of Piney Creek at Kearney, Wyo., during the year ending Sept. 30, 1917.

[Made by P. V. Hodges.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 17	4.28	984
July 31	1.82	59

Daily discharge, in second-feet, of Piney Creek at Kearney, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Day.	Oct.	Nov.	Apr.	May.	June.	July.
1	18	38	....	44	444	298	16	13	....	50	397	746	62
2	18	36	....	44	420	248	17	13	....	50	397	1,100	32
3	18	36	....	44	332	206	18	13	....	50	420	1,050	40
4	18	34	....	50	353	178	19	13	....	39	420	938	41
5	18	34	....	44	374	206	20	13	....	56	680	944	141
6	18	34	....	63	332	181	21	13	....	59	494	834	63
7	18	34	....	67	546	270	22	13	....	63	444	889	110
8	20	34	50	78	730	270	23	13	....	95	374	840	48
9	20	34	63	78	730	212	24	23	....	78	374	840	75
10	20	34	68	86	784	257	25	34	....	70	374	894	76
11	20	34	50	114	779	212	26	39	....	70	374	735	84
12	18	34	63	136	562	173	27	39	....	70	420	845	93
13	13	....	63	186	411	99	28	39	....	56	420	653	78
14	13	....	56	260	454	56	29	39	....	44	444	600	95
15	13	....	50	374	531	60	30	39	....	54	420	425	80
							31	39	....	....	397	....	59

Monthly discharge of Piney Creek at Kearney, Wyo., for the year ending Sept. 30, 1917

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	39	13	21.2	1,30[illegible]
November 1-12	38	34	34.7	82[illegible]
April 8-30	95	44	59.2	2,70[illegible]
May	680	44	275	16,90[illegible]
June	1,100	332	670	39,90[illegible]
July	298	32	132	8,12[illegible]

PINEY CREEK AT UCROSS, WYO.

LOCATION.—In NW. ¼ sec. 18, T. 53 N., R. 80 W., at highway bridge a quarter of a mile from Ucross, in Sheridan County. No tributary between station and mouth, half a mile below.

DRAINAGE AREA.—253 square miles (measured on base map of Wyoming; scale 1 : 500,000).

RECORDS AVAILABLE.—May 12 to September 30, 1917.

GAGE.—Chain gage attached to highway bridge; read by Miss Alma Larsen.

DISCHARGE MEASUREMENTS.—Made from highway bridge or by wading 200 feet downstream.

CHANNEL AND CONTROL.—Bed composed of silt and gravel which will shift. Control 50 feet downstream at riffle composed of compact gravel; shifted slightly during 1917. Banks not subject to overflow.

ICE.—Stage-discharge relation affected by ice.

EXTREME OF DISCHARGE.—Maximum stage recorded during period, 4.2 feet at 11 a. m. June 20 (discharge, 1,070 second-feet); minimum stage recorded, 1.3 feet at 8.20 a. m. July 20 (discharge, 4 second-feet).

DIVERSIONS.—Prior to December 31, 1916, adjudicated diversions of 351 second-feet from Piney Creek, all above station.

REGULATION.—Head waters are chain of small mountain lakes, the largest of which, Cloud Peak, is used as reservoir for irrigation. Alternate melting and freezing of mountain snow in spring of year causes some diurnal fluctuation.

ACCURACY.—Stage-discharge relation slightly shifting; affected by ice during winter. Rating curve well defined between 6 and 1,200 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to the rating table; shifting-control method used August 21 to September 30. Records good, June 8 to August 20; fair, August 21 to September 30.

Discharge measurements of Piney Creek at Ucross, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 12	J. C. Beebe	2.45	172	July 31	Hodges and Beebe	1.76	35.0
June 16	P. V. Hodges	3.90	818	Aug. 7	Mull	1.50	13.9
20	Hodges and Beebe	4.22	1,100	14	....do		7.07
July 5	J. C. Beebe	2.60	304	30	....do	1.45	14.2
14	....do	1.90	45.9	Sept. 29	P. V. Hodges	1.59	16.6
19	....do	1.40	6.0				

Daily discharge, in second-feet, of Piney Creek at Ucross, Wyo., for the year ending Sept. 30, 1917.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1			290	24	11	16		768	37	7.0	14
2			227	14	11	17		910	27	6.4	18
3			190	13	11	18		871	7.7	7.0	18
4			160	10	11	19		858	5.8	6.7	18
5			196	14	11	20		988	4.6	21	20
6			175	20	10	21		832	35	34	18
7			160	17	10	22		832	24	37	18
8		406	190	14	10	23		750	21	34	18
9		535	227	14	10	24		665	22	29	18
10		750	178	13	10	25	485	878	20	28	17
11		878	184	8.4	8.4	26		750	17	22	17
12	175	665	150	8.4	6.4	27		665	28	24	17
13		485	87	7.0	8.4	28		610	44	20	17
14	196	438	53	5.8	8.4	29		510	55	15	17
15		535	50	6.4	9.8	30		500	42	12	17
						31			32	13	

NOTE.—Sept. 2-9, 16, 18, 23-28, and 30, no gage-height record; discharge interpolated.

Monthly discharge of Piney Creek at Ucross, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
June 8-30	988	406	699	31,900
July	290	4.6	94.8	5,830
August	37	5.8	16.3	1,000
September	20	6.4	13.6	809
The period				39,500

LITTLE MISSOURI RIVER BASIN.

LITTLE MISSOURI RIVER NEAR ALZADA, MONT.

LOCATION.—Near southwest corner of T. 8 S., R. 60 E., at Walker's ranch, 300 yards below site of proposed dam, 2 miles below mouth of Thompson Creek, and 4 miles below Alzada, in Fallon County.

DRAINAGE AREA.—780 square miles.

RECORDS AVAILABLE.—June 18, 1911, to September 30, 1917.

GAGE.—Overhanging chain gage on right bank, read by John Walker; gage used during 1911 was vertical staff on left bank, 150 feet downstream. Datum of chain gage 0.08 foot lower than that of staff gage.

DISCHARGE MEASUREMENTS.—Made by wading or from cable.

CHANNEL AND CONTROL.—Bed shifts during high water. Stream sluggish. Banks cut 5 to 15 feet in sandy soil. Two channels at medium and one at high stage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.18 feet at 7 p. m. April 11 (discharge, 3,250 second-feet); channel dry October 1–7, January 4–6, and September 19–30, (discharge, 0).

1911–1917: Maximum stage recorded, 15.3 feet April 6, 1912 (discharge, 4,550 second-feet); minimum stage, channel dry July 6 to August 7, and October 14–18, 1911; September 9–15, 1913; September 8–10, 12–30, and October 1–7, 1916; January 4–6, 1917, and September 19–30, 1917.

ICE.—Stage-discharge relation seriously affected by ice. Data obtained is inadequate to estimate winter flow. Discharge not computed January 13 to March 26.

DIVERSIONS.—None.

REGULATION.—None of importance. Some flood water in spring is stored in coulees on tributaries for use in irrigating small tracts.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 80 and 2,000 second-feet. Gage read to quarter-tenths twice daily. Daily dis charge obtained by applying mean daily gage height to rating table. Records good.

No discharge measurements were made during the year.

Daily discharge, in second-feet, of Little Missouri River near Alzada, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	0	5.2	9.0	1.0	....	1,600	184	162	9.0	2.2	4.8
2	0	5.2	9.0	.8	....	1,080	111	116	8.0	2.2	5.6
3	0	5.2	8.5	.5	....	1,060	140	66	7.6	1.3	6.4
4	0	4.8	9.0	.0	....	1,030	173	56	7.2	1.3	4.8
5	0	4.8	9.0	.0	....	1,170	206	122	6.4	1.3	4.0
6	0	6.0	8.5	.0	....	1,550	116	173	5.6	1.3	3.4
7	0	7.2	8.0	.7	....	1,740	68	173	4.8	1.6	2.5
8	6.4	7.6	7.6	.5	....	1,770	56	88	5.6	1.6	2.2
9	13	7.6	7.2	.6	....	1,830	47	56	4.4	1.6	1.6
10	45	7.6	6.0	.7	....	1,860	41	43	4.4	2.2	1.0
11	37	5.6	5.2	.7	....	3,020	37	37	4.4	7.6	2.2
12	25	4.0	5.6	.6	....	2,740	34	33	4.4	12	1.3
13	19	2.8	6.0	....	....	1,280	31	24	4.0	85	.8
14	16	4.0	6.0	....	....	1,030	25	20	5.2	20	.6
15	12	5.6	6.0	....	....	922	23	16	5.2	12	.5
16	9	6.0	6.8	....	....	550	22	14	4.8	9.0	.6
17	11	6.0	6.8	....	....	518	13	12	4.0	39	.4
18	10	6.4	6.8	....	....	430	20	11	4.0	17	.4
19	10	7.2	6.8	....	....	265	20	10	4.0	10	.0
20	10	14	6.4	....	....	217	25	14	4.8	19	.0
21	10	13	5.2	....	....	162	29	14	5.6	16	.0
22	9	12	4.8	....	....	140	31	14	5.6	9.0	.0
23	8	12	4.0	....	....	140	28	14	4.4	4.8	.0
24	7.6	11	3.1	....	....	162	36	12	4.4	4.0	.0
25	7.6	10	2.8	....	....	130	51	12	3.7	3.4	.6
26	8.0	10	2.6	....	....	162	51	11	2.8	2.8	.0
27	7.6	10	2.4	....	120	96	45	22	2.8	2.5	.0
28	7.2	10	2.2	....	128	109	41	19	3.1	1.6	.0
29	7.2	9.5	1.6	....	173	306	49	12	3.7	1.3	.0
30	7.2	9.0	1.0	....	860	352	49	11	3.1	1.0	.0
31	5.6	....	1.0	....	1,710	....	184	....	2.8	2.5	....

Monthly discharge of Little Missouri River at Alzada, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	45	0.0	9.95	612
November	14	2.8	7.64	455
December	9.0	1.0	5.64	347
January 1-12	1.0	.0	.51	12.1
March 27-31	1,710	120	598	5,930
April	3,020	96	914	54,400
May	206	13	64.1	3,940
June	173	10	46.2	2,750
July	9.0	2.8	4.83	297
August	85	1.0	9.55	587
September	6.4	.0	1.44	85.7

KNIFE RIVER BASIN.

KNIFE RIVER NEAR BRONCHO, N. DAK.

LOCATION.—In SE. ¼ sec. 4, T. 142 N., R. 90 W., at ranch half a mile below mouth of Elm Creek, 15 miles above Spring Creek, and 6 miles from Broncho, in Mercer County.

DRAINAGE AREA.—1,260 square miles; drainage area at original location 2 miles downstream, probably 5 square miles greater.

RECORDS AVAILABLE.—May 29, 1903, to September 30, 1917.

GAGE.—Chain on cantilever timber on left bank near observer's house; datum unchanged since March 23, 1905. Gage read by C. D. Smith.

DISCHARGE MEASUREMENTS.—Made from cable 500 feet below gage or by wading.

CHANNEL AND CONTROL.—Stream bed below gage large gravel and stones, nearly permanent. Channel narrow with steep banks which are not overflowed at gage heights less than 20 feet.

EXTREMES OF DISCHARGE.—Maximum stage during year, 17.0 feet March 30, caused by ice jam; maximum discharge, 1,480 second-feet, March 31; minimum stage, 3.3 feet September 10 (discharge, 4 second-feet); river reported dry September 6–8, 1905, and September 18–19, 1908.

ICE.—Stage-discharge relation seriously affected by ice and gage records discontinued during part of winter.

ACCURACY.—Stage-discharge relation practically permanent during the year, except as affected by ice. Rating curve fairly well defined below 2,000 second-feet. Gage read to tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good. Indirect method used March 27 to April 9, because of ice. Records fair.

Discharge measurements of Knife River near Broncho, N. Dak., during the year ending Sept. 30, 1917.

[Made by V. H. Sprague.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Mar. 31	[a]16.71	1,587
July 16	3.49	10.2

[a] Backwater from ice.

Daily discharge, in second-feet, of Knife River near Broncho, N. Dak., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	11	16		1,320	124	27	21	11	4
2	11	16		1,210	90	27	16	7	4
3	21	16		1,100	80	27	16	7	4
4	21	16		712	62	27	16	7	4
5	21	16		627	62	27	16	7	4
6	21	16		683	54	27	16	7	4
7	21	16		925	54	33	16	7	4
8	21	16		1,100	47	33	16	7	4
9	16	16		655	47	33	16	7	4
10	16	16		655	47	47	16	7	4
11	16			925	47	44	16	7	4
12	16			1,320	40	40	16	7	4
13	16			958	40	40	16	7	4
14	16			296	40	33	16	7	4
15	16			354	40	33	11	7	4
16	16			278	40	27	11	7	4
17	16			164	40	27	7	7	4
18	16			179	40	27	7	7	4
19	16			164	33	21	7	7	4
20	16			315	33	21	7	7	4
21	16			296	33	21	7	7	4
22	16			278	33	27	7	7	4
23	21			226	33	27	7	7	4
24	21			194	33	27	7	4	4
25	21			179	33	27	7	4	4
26	21			210	33	27	4	4	4
27	16		100	243	33	33	4	4	4
28	16		627	226	33	27	4	4	4
29	16		741	194	27	27	4	4	4
30	16		1,100	179	27	21	4	4	4
31	16		1,480		27		11	4	

NOTE.—After Nov. 10, the discharge decreased gradually and during February and the first three weeks in March it was probably only a few second-feet.

Monthly discharge of Knife River near Broncho, N. Dak., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	21	11	17.3	1,060
November 1-10	16	16	16	317
April	1,320	164	539	32,100
May	124	27	45.3	2,790
June	47	21	29.5	1,760
July	21	4	11.1	682
August	11	4	6.35	390
September	4	4	4.0	238

NOTE.—See footnote to daily discharge table.

HEART RIVER BASIN.

HEART RIVER NEAR RICHARDTON, N. DAK.

LOCATION.—In sec. 21, T. 138 N., R. 92 W., opposite residence of W. F. Church, 1 mile below highway bridge and 11 miles south of Richardton.

DRAINAGE AREA.—1,250 square miles.

RECORDS AVAILABLE.—May 18, 1903, to September 30, 1917.

GAGE.—Chain on cantilever timber opposite observer's house, on right bank of river. Auxiliary chain gage on highway bridge 1 mile above observer's house, used March 23 to June 1, 1917, because of damage to regular gage. The two gage datums are so related that readings at the bridge are approximately 10.0 feet less than on the gage regularly used.

DISCHARGE MEASUREMENTS.—At high stages from bridge; at ordinary low stages by wading.

CHANNEL AND CONTROL.—Channel fairly permanent, but control sometimes changed considerably during part of year by the building of dams by beavers a quarter of a mile below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 33.7 feet April 1 (discharge, 1,850 second-feet); minimum stage, 25.2 feet August 25 (discharge, 0.4 second-foot).

1903–1917: Maximum stage recorded, 25.9 feet from chain gage at highway bridge June 10, 1906 (discharge, 8,020 second-feet); river reported dry July 26 to August 11, August 20–23, 1903, September 1–19, 1905, July 22–27, 1914.

ICE.—Stage-discharge relation seriously affected by ice; flow estimated from observer's reports and gage heights and weather records. Winter flow very small.

REGULATION AND DIVERSIONS.—No storage or diversions appreciably affecting the discharge.

ACCURACY.—Stage-discharge relation affected by dam built by beavers. Rating curve poorly defined. Gage read to half-tenths once daily. Discharge determined by shifting-control method. Records poor.

Discharge measurements of Heart River near Richardton, N. Dak., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Mar. 30	V. H. Sprague	33.48	1,561
July 16	.....do	24.98	7.7
Aug. 28	E. F. Chandler	25.24	.4

Daily discharge, in second-feet, of Heart River near Richardton, N. Dak., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	24	17	....	1,850	226	41	11	2.5	0.6
2	28	20	....	1,850	138	36	11	1.6	.6
3	24	17	....	1,850	138	41	14	1.6	.6
4	24	14	....	1,670	138	41	14	2	.6
5	28	14	....	1,470	132	45	20	1.6	.6
6	24	14	....	1,500	152	50	17	.8	.8
7	24	14	....	1,470	113	65	17	.8	.8
8	28	17	....	1,410	102	60	24	1.3	.8
9	28	17	....	1,560	102	55	24	1.3	.8
10	24	14	....	1,210	102	55	28	1.3	1.0
11	24	14	....	1,150	102	41	20	.8	1.0
12	24	....	....	940	91	32	17	1.0	1.6
13	24	....	....	651	91	36	14	1.3	1.3
14	24	....	....	485	91	36	11	1.0	1.6
15	24	....	....	409	80	32	8	1.0	2
16	24	....	....	372	70	28	8	1.0	1.6
17	24	....	....	466	70	24	8	1.0	2
18	24	....	....	409	70	24	11	.8	2
19	20	....	....	354	50	24	11	.6	2
20	24	....	....	320	50	24	11	.6	2
21	20	....	....	288	70	17	6	.5	2
22	24	....	....	320	60	24	3	.5	2
23	20	....	226	320	60	28	3	.5	2
24	17	....	256	304	60	28	3	.5	2.5
25	17	....	372	288	50	41	2.5	.4	2.5
26	17	....	409	272	50	36	2.5	.4	2.5
27	17	....	545	337	41	24	4.5	.4	2.5
28	17	....	810	337	41	24	3	.4	2
29	17	....	940	288	41	24	3	.4	2
30	17	....	1,640	256	41	17	2.5	.4	2
31	20	....	1,610	....	41	....	4.5	.5	....

NOTE.—After Nov. 11, discharge decreased gradually and during February and first 3 weeks in March amounted to only a few second-feet.

Monthly discharge of Heart River near Richardton, N. Dak., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	28	17	22.4	1,380
April	1,850	256	814	48,400
May	226	41	85.9	5,280
June	65	17	35.1	2,090
July	28	2.5	10.9	670
August	2.5	.4	.90	55
September	2.5	.6	1.54	92

CANNONBALL RIVER BASIN.

CANNONBALL RIVER NEAR STEVENSON, N. DAK.

LOCATION.—At boundary of Standing Rock Indian Reservation in NW. ¼, sec. 21, T. 133 N., R. 82 W., 60 rods above house of observer, F. Bingenheimer; 2 miles southeast of Stevenson schoolhouse, 4 miles south of Timmer, N. Dak., and 4 miles above mouth of Dogtooth Creek. From 1911 to 1915 records were maintained at M. H. Burdick's, 1 mile farther upstream.

DRAINAGE AREA.—3,650 square miles.

RECORDS AVAILABLE.—June 10, 1903, November 30, 1908; August 9, 1911, to September 30, 1917.

GAGE.—Chain gage on projecting cantilever timber at left bank. Datum of the gage is precisely the same as the datum of the gage maintained at the same point from 1903 to 1910. Read by F. Bingenheimer.

Discharge measurements.—At low and medium stages made by wading at rapids a few rods below observer's house; at medium and high stages measurements are made by use of car and cable 20 rods above the gage.

Channel and control.—At the rapids at the ford 20 rods below the gage the bed is of stones and small boulders. Control has not changed considerably.

Extremes of discharge.—Maximum stage recorded during year, 9.4 feet April 5, caused by ice jams; maximum discharge, 1,880 second-feet April 13; minimum stage, 2.5 feet September 5 (discharge, 2 second-feet).

1903–1908 and 1911–1918: Maximum stage recorded, 21.05 feet (equivalent to 11.05 feet at present location) April 2, 1912 (discharge, 6,560 second-feet); no flow during periods each year 1904–1908 and 1913.

Ice.—Stage-discharge relation seriously affected by ice.

Regulation.—No dams or diversions appreciably affect the flow.

Accuracy.—Stage-discharge relation nearly permanent. Rating curve fairly well defined. Gage read to half-tenths daily. Daily discharge ascertained by applying daily gage height to rating table; indirect method used March 27 to April 10 because of ice. Records fair.

Discharge measurements of Cannonball River near Stevenson, N. Dak., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 24	T. M. Wardwell	2.90	13.1	June 20	Alf Hulteng	3.29	71
Apr. 12	L. B. Dale	6.45	1,487	July 25	E. F. Chandler	2.76	7.4
May 22	Alf Hulteng	3.58	92	Aug 25	....do	2.60	2.9

Daily discharge, in second-feet, of Cannonball River near Stevenson, N. Dak., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	8	14		590	302	71	47	5	2
2	8	14		770	222	62	47	3	2
3	8	14		900	190	54	34	2	2
4	8	14		900	190	47	34	2	2
5	8	23		1,030	222	80	34	2	2
6	8	23		1,450	190	100	28	2	2
7	8	23		535	161	90	28	2	2
8	8	23		770	161	80	23	2	2
9	8	23		1,170	161	71	23	2	2
10	8	23		1,520	134	71	23	2	2
11	8	23		1,730	111	134	23	2	2
12	8			1,730	161	122	14	2	2
13	8			1,880	134	80	14	2	2
14	8			1,880	134	71	14	2	23
15	8			1,730	90	62	11	2	8
16	8			1,450	134	54	8	2.5	6
17	8			1,170	111	100	6	3	5
18	8			1,060	111	80	6	3	4
19	8			932	90	62	6	3	3
20	8			802	111	62	5	3	3
21	14			740	134	62	5	3	3
22	14			680	111	80	5	3	3
23	14			620	90	62	4	3	3
24	14			620	111	80	4	2.5	3
25	14			562	111	62	5	3	3
26	14			508	71	62	5	2.5	2.5
27	14		147	452	90	62	5	2.5	2.5
28	14		325	350	80	62	5	2	2.5
29	14		325	350	80	54	14	2	2
30	14		325	350	80	47	34	2	2
31	14		535		90		47	2	

Monthly discharge of Cannonball River near Stevenson, N. Dak., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	14	8	10.1	623
April	1,880	350	974	58,000
May	302	71	134	8,240
June	134	47	72.9	4,340
July	47	4	18.1	1,110
August	8	2	2.77	170
September	23	2	3.48	207

GRAND RIVER BASIN.

NORTH BRANCH OF GRAND RIVER AT HALEY, N. DAK.

LOCATION.—At highway bridge near northeast corner of sec. 36, T. 129 N., R. 100 W., about 20 rods south of post office at Haley, in Bowman County.

DRAINAGE AREA.—500 square miles.

RECORDS AVAILABLE.—May 17, 1908, to September 30, 1917.

GAGE.—Stage obtained by measuring distance from bench mark on highway bridge to water surface by means of a metallic tape weighted at the end. From 1908 to 1911 a vertical staff gage 100 feet above the present bridge was used. Gage read by Wesley Nelson.

DISCHARGE MEASUREMENTS.—Made from highway bridge or by wading.

CHANNEL AND CONTROL.—Bed of stream gravel and sand; fairly permanen .

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.2 feet April 6, obstructed by ice; maximum discharge, 602 second-feet April 9; no flow June 25–28.

1908–1917: Maximum stage recorded, 9.85 feet June 13, 1915 (discharge, 3,500 second-feet); no flow June 25–28, 1917.

ICE.—Stage-discharge relation seriously affected by ice; gage observations discontinued during winter.

REGULATION.—Flow not appreciably affected by any diversions or dams above station.

ACCURACY.—Stage-discharge relation presumably nearly permanent, except when affected by ice. Gage read daily during floods and twice weekly through remainder of season, to half-tenths. Records roughly approximate.

The following discharge measurement was made by E. F. Chandler:

August 23, 1917: Gage height, 0.86 foot; discharge, 0.2 second-foot.

Monthly discharge of Grand River near Wakpala, S. Dak., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	23	13	18.9	1,150
April	2,000	520	1,190	71,100
May	980	85	217	13,300
June	215	105	131	7,820
July	215	15	105	6,470
August	1,040	2	131	8,080
September	6	2	4.5	268

CHEYENNE RIVER BASIN.

CHEYENNE RIVER NEAR HOT SPRINGS,[1] S. DAK.

Location.—In sec. 9, T. 9 S., R. 5 E., 1 mile above dam site of proposed Angostura irrigation project, 5 miles south of Cascade Springs, and 11 miles south of Hot Springs, Fall River County. Nearest tributary, Cascade creek, enters 2½ miles above.

Drainage area.—Not measured.

Records available.—September 11, 1914, to September 30, 1917. Station maintained at Edgemont June 19, 1903, to November 30, 1906, but flow is not directly comparable, as a number of small tributaries intervene.

Gage.—Inclined slope gage on right bank one-third of a mile below Noerenberg's fruit farm; read by Fred Noerenberg. Friez water-stage recorder used prior to April 2, 1915, but abandoned, as stream carries too much silt during flood.

Discharge measurements.—Made from cable 75 feet below gage or by wading.

Channel and control.—Bed composed of compacted gravel on which silt is deposited; shifts frequently. Principal control a short distance downstream; shifts during severe floods. Right bank subject to overflow for distance of 100 feet at stage of 14 feet.

Extremes of discharge.—Maximum stage recorded during year, 10.80 feet at 11 p. m. May 22 (discharge, 16,100 second-feet); minimum stage, 0.40 foot on September 6 (discharge, 10 second-feet).

Ice.—Spring water from Cascade creek prevents formation of ice, except for brief periods.

Diversions.—Permits granted for diversions amounting to 93.4 second-feet from Cheyenne River above station, and 43.4 second-feet from Cascade creek.

Regulation.—None.

Accuracy.—Stage-discharge relation not permanent; affected by ice for short periods during winter. Rating curve well defined between 20 and 20,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except for period May 24 to September 30. when discharge was computed by the indirect method for shifting control. Records good, except for periods affected by ice, when they are fair.

Discharge measurements of Cheyenne River near Hot Springs, S. Dak., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 31	Fred Noerenberg	0.83	27.2	July 27	P. V. Hodges	0.68	36.4
Apr. 20	do	3.73	1,500	Aug. 29	Fred Noerenberg	.71	26.2
May 23	do	4.64	2,660				

[1] Formerly Cheyenne River near Cascade Springs, S. Dak.

Daily discharge, in second-feet, of Cheyenne River near Hot Springs, S. Dak., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	27	49	34	24	20	349	3,270	953	1,680	166	18	18
2	32	38	32	23	20	98	2,290	1,680	1,420	112	18	17
3	34	38	29	23	21	49	1,110	3,270	916	90	18	14
4	38	36	29	22	21	38	614	3,730	3,500	76	14	14
5	38	35	29	22	22	38	530	1,910	6,860	58	24	12
6	37	35	39	22	22	62	586	1,190	3,500	52	18	10
7	36	36	34	22	20	62	530	806	1,280	47	24	11
8	38	38	34	22	20	49	476	476	916	44	32	14
9	45	38	34	22	20	62	586	374	706	125	44	16
10	45	40	34	21	20	62	398	302	502	125	50	17
11	45	44	34	21	20	88	530	222	398	36	53	20
12	41	49	32	20	21	62	614	153	349	20	130	20
13	38	49	32	20	22	38	644	186	330	16	28	17
14	38	49	31	20	22	34	586	176	254	16	18	17
15	35	49	30	22	26	49	557	133	207	26	16	16
16	35	44	29	24	258	38	502	92	156	18	14	22
17	38	40	26	26	122	29	449	88	150	12	18	49
18	38	38	24	26	150	22	772	59	166	46	41	32
19	38	36	22	26	218	38	614	75	298	18	250	26
20	40	35	22	22	258	62	1,370	2,700	182	14	1,090	22
21	41	35	22	23	182	122	878	5,230	189	12	662	22
22	44	34	22	25	122	218	557	13,900	144	11	211	20
23	62	49	22	26	78	98	398	3,890	125	11	105	20
24	78	70	22	28	70	349	246	1,520	321	11	105	35
25	70	49	22	29	78	1,370	176	1,240	298	11	67	56
26	62	44	22	29	200	2,290	204	2,360	182	31	34	49
27	62	40	23	26	258	1,570	238	5,320	112	36	29	41
28	78	38	23	22	738	1,280	258	4,050	330	24	26	22
29	78	36	23	20	....	3,120	211	1,570	298	36	26	20
30	62	35	24	18	....	4,050	238	1,370	254	20	26	20
31	56	....	24	18	....	3,120	....	1,680	....	16	20	....

NOTE.—Nov. 13-14, Dec. 13-15, 20-22, 26-30, Jan. 13-18, 21-24, 31-Feb. 4, stage-discharge relation affected by ice. Discharge based on temperature and gage-height record, discharge measurements, and observer's notes.

Monthly discharge of Cheyenne River near Hot Springs, S. Dak., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	78	27	46.7	2,870
November	70	34	41.5	2,470
December	34	22	27.4	1,680
January	29	18	23.0	1,410
February	738	20	109	6,050
March	4,050	22	610	37,500
April	3,270	176	681	40,500
May	13,900	59	1,960	121,000
June	6,860	112	867	51,600
July	166	11	43.1	2,650
August	1,090	14	104	6,400
September	56	10	23.0	1,370
The year	13,900	10	380	276,000

RAPID CREEK AT BIG BEND, S. DAK.

LOCATION.—In NW. ¼ sec. 8, T. 1 N., R. 6 E., at Big Bend, in Pennington County. Nearest tributary, Deer Creek, enters 2½ miles upstream.

DRAINAGE AREA.—332 square miles (measured on topographic map).

RECORDS AVAILABLE.—March 23, 1915, to September 30, 1917.

GAGE.—Vertical staff just below tailrace of Dakota Power Co.; read by power-house operator.

DISCHARGE MEASUREMENTS.—Medium and low stage measurements by wading.

CHANNEL AND CONTROL.—Shifts at long intervals.

Ice.—Stage-discharge relation affected by ice during some winters.

Diversions.—Dakota Power Co. diverts water above station but returns it just above gage.

Cooperation.—Station maintained by Dakota Power Co. Records furnished through courtesy of United States Forest Service.

Daily discharge, in second-feet, of Rapid Creek at Big Bend, S. Dak., for the period Mar. 23, 1915, to Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915.												
1	......	......	......	......	......	......	30	130	115	204	312	340
2	......	......	......	......	......	......	28	178	149	204	328	311
3	......	......	......	......	......	......	35	328	166	183	295	295
4	......	......	......	......	......	......	47	270	198	173	267	254
5	......	......	......	......	......	......	59	257	236	160	248	264
6	......	......	......	......	......	......	71	227	210	145	218	242
7	......	......	......	......	......	......	81	204	178	153	233	242
8	......	......	......	......	......	......	83	212	166	156	218	224
9	......	......	......	......	......	......	89	180	160	136	233	224
10	......	......	......	......	......	......	109	178	165	138	233	198
11	......	......	......	......	......	......	92	183	185	131	242	190
12	......	......	......	......	......	......	83	180	185	142	248	188
13	......	......	......	......	......	......	99	162	198	145	295	210
14	......	......	......	......	......	......	136	156	178	147	233	185
15	......	......	......	......	......	......	145	151	164	125	306	167
16	......	......	......	......	......	......	156	143	173	193	378	149
17	......	......	......	......	......	......	185	149	173	273	368	158
18	......	......	......	......	......	......	156	145	233	227	439	142
19	......	......	......	......	......	......	128	128	344	185	446	133
20	......	......	......	......	......	......	102	130	395	193	378	136
21	......	......	......	......	......	......	109	130	361	193	429	133
22	......	......	......	......	......	......	91	125	321	178	395	112
23	......	......	......	......	......	22	95	118	308	156	337	112
24	......	......	......	......	......	37	102	104	295	149	318	114
25	......	......	......	......	......	17	105	142	273	166	328	114
26	......	......	......	......	......	26	91	142	236	248	616	120
27	......	......	......	......	......	26	88	120	233	218	531	138
28	......	......	......	......	......	30	89	128	218	212	497	149
29	......	......	......	......	......	30	73	120	207	173	395	131
30	......	......	......	......	......	30	84	114	204	251	405	125
31	......	......	......	......	......	31	......	117	......	295	368	......
1915–16.												
1	124	73	43	......	......	......	81	119	......	122	75	69
2	122	77	52	......	......	......	79	119	......	121	67	58
3	112	72	60	......	......	......	67	111	......	111	63	49
4	122	72	61	......	......	......	69	108	......	108	69	53
5	114	69	79	......	......	......	70	111	......	114	71	45
6	111	73	69	......	......	......	71	108	......	97	61	44
7	108	83	41	......	......	......	63	95	......	95	75	41
8	104	83	74	......	......	......	46	90	......	83	67	46
9	102	74	66	......	......	......	69	87	......	91	58	48
10	97	68	65	......	......	......	83	79	......	83	58	44
11	101	61	39	......	......	......	81	87	......	117	62	46
12	95	61	56	......	......	......	98	91	......	104	66	46
13	92	55	59	......	......	......	95	101	......	94	57	50
14	89	49	59	......	......	......	90	104	......	91	64	50
15	102	43	56	......	......	55	92	112	......	83	64	46
16	115	37	52	......	......	66	92	117	......	91	62	44
17	94	66	35	......	......	84	92	117	......	101	56	51
18	102	65	43	......	......	87	95	124	......	100	55	46
19	92	65	29	......	......	92	117	124	......	91	50	45
20	102	67	33	......	......	90	122	138	......	81	51	47
21	88	87	38	......	......	98	129	176	......	81	64	46
22	83	60	57	......	......	104	111	180	......	76	78	48
23	83	68	50	......	......	101	117	191	......	84	57	46
24	95	65	61	......	......	91	129	204	......	69	47	39
25	86	66	66	......	......	46	116	204	......	68	51	48
26	77	60	68	......	......	58	114	187	......	69	53	46
27	79	47	50	......	......	95	109	180	......	63	56	47
28	69	42	50	......	......	95	114	182	......	61	58	51
29	60	34	50	......	......	84	109	173	......	76	47	46
30	78	42	50	......	......	79	106	173	......	72	76	45
31	73	......	48	......	......	62	......	159	......	75	72	......

Daily discharge, in second-feet, of Rapid Creek at Big Bend, S. Dak., for the period Mar. 23, 1915, to Sept. 30, 1917—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1916–17.												
1	46	54	......	34	26	27	32	78	247	100	49	44
2	52	60	......	34	26	28	33	82	240	102	51	46
3	44	49	......	34	27	27	40	83	224	93	45	46
4	46	60	......	35	28	27	22	78	270	146	49	44
5	52	56	......	36	28	28	22	92	270	92	40	41
6	44	60	......	36	29	28	22	94	247	89	53	43
7	53	54	......	37	28	30	21	102	218	96	70	40
8	50	39	......	37	29	30	20	102	216	86	61	41
9	60	52	......	37	29	29	33	96	200	82	60	42
10	51	56	......	36	28	29	58	95	205	72	52	40
11	48	40	......	35	28	28	48	102	198	66	51	39
12	51	32	......	35	28	28	40	96	184	72	58	40
13	56	26	......	33	28	28	50	120	188	68	56	35
14	49	26	......	33	28	28	51	125	168	76	50	34
15	54	46	......	33	28	28	45	130	166	71	58	38
16	50	58	......	32	29	28	38	141	144	70	56	35
17	54	60	......	34	28	28	43	144	152	64	54	46
18	48	84	......	34	28	28	57	136	144	57	67	47
19	60	60	......	36	28	30	72	132	153	57	51	47
20	45	71	......	37	28	30	57	178	138	62	68	47
21	48	55	......	35	28	30	60	244	164	54	72	45
22	60	46	......	30	28	30	70	210	141	40	60	40
23	57	60	......	32	28	29	74	210	144	52	51	40
24	52	35	......	30	28	30	77	192	138	50	48	34
25	49	46	......	31	28	30	85	198	132	53	43	40
26	56	62	......	31	28	29	72	240	126	56	49	40
27	56	66	......	31	28	29	75	244	128	57	46	36
28	56	56	......	31	27	29	67	226	132	44	45	39
29	54	47	......	32	......	26	65	240	124	30	45	37
30	56	38	......	31	......	25	64	255	112	46	48	39
31	54	......	......	27	......	28	......	255	......	49	47	......

NOTE.—No gage-height record, Apr. 4–5, Aug. 1, 15, Sept. 1 and 15, 1915; discharge interpolated. Discharge Dec. 13 and 29, 1915, estimated because of ice.

Monthly discharge of Rapid Creek at Big Bend, S. Dak., for the period Mar. 23, 1915, to Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1915.				
March 23–31	37	17	27.7	494
April	185	28	94.7	5,640
May	328	104	163	10,000
June	395	115	221	13,200
July	295	125	182	11,200
August	616	218	340	20,900
September	340	112	183	10,900
The period	....	....	....	72,300
1915–16.				
October	124	60	95.5	5,870
November	83	34	61.1	3,640
December	79	29	53.8	3,310
January	....	....	49	3,010
February	....	....	52	2,990
March	104	....	69.6	4,280
April	129	46	94.2	5,610
May	204	79	134	8,240
June	....	....	153	9,100
July	122	61	89.4	5,500
August	78	47	61.6	3,790
September	69	39	47.7	2,840
The year	....	....	80.1	58,200

Monthly discharge of Rapid Creek at Big Bend, S. Dak., for the period Mar. 23, 1915, to Sept. 30, 1917—Continued.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1916-17.				
October	60	44	52.0	3,200
November	84	26	51.8	3,080
January	37	27	33.5	2,060
February	29	26	27.9	1,550
March	30	25	28.5	1,750
April	85	20	50.4	3,000
May	255	78	152	9,350
June	270	112	177	10,500
July	146	30	69.4	4,270
August	72	40	53.3	3,280
September	47	34	40.8	2,430

NOTE.—Discharge Jan. 1 to Mar. 14, 1916, estimated because of ice. No gage-height record June 1-30, 1916; discharge estimated from comparison with Rapid Creek at Rapid City.

BELLE FOURCHE RIVER NEAR BELLE FOURCHE, S. DAK.

LOCATION.—In sec. 2, T. 8 N., R. 2 E., at diversion dam of Belle Fourche irrigation project, 1½ miles below Belle Fourche, in Butte County.

DRAINAGE AREA.—4,270 square miles.

RECORDS AVAILABLE.—May 10 to November 30, 1906; January 1, 1912, to September 30, 1917. May 26, 1903, to June 23, 1906, for station at the west outskirts of Belle Fourche; the records at these points are not directly comparable, as Redwater River enters between the two stations, and water is diverted from Belle Fourche River.

GAGE.—Inclined staff 100 feet from crest of diversion dam, and a gage in canal. See "Computation of discharge."

COMPUTATION OF DISCHARGE.—The following information was supplied by the United States Reclamation Service:

The records of daily discharge represent the entire flow of the river at the diversion dam and have been corrected for water diverted through Inlet canal and passed through the sluice gages. The diversion dam acts as a weir; the crest is 400 feet long; the gage is about 100 feet from the crest and is read twice daily. Careful discharge measurements were made in the river above and below the dam before the coefficient was established, and the discharge rating table as originally computed has not been changed. The quantity diverted is determined at a gaging station maintained on Inlet canal, and the rating curve is checked by frequent discharge measurements. The sluice gates are seldom used and the flow through them is estimated.

DIVERSIONS.—In that part of the drainage area in Wyoming there were, prior to July 1, 1914, adjudicated diversions of 25 second-feet from Belle Fourche River and 237 second-feet from tributaries. In South Dakota there are authorized diversions of 102 second-feet from Belle Fourche River above the gaging station and approximately 2,500 second-feet from tributaries; below the station there are authorized diversions of 3,102 second-feet from Belle Fourche River.

ACCURACY.—The United States Reclamation Service considers the records fair.

COOPERATION.—Complete records furnished and stations maintained by United States Reclamation Service.

Daily discharge, in second-feet, of Belle Fourche River near Belle Fourche, S. Dak., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	177	245	115	206	173	235	2,500	483	477	50	9	25
2	177	245	115	215	173	235	3,680	465	597	52	9	30
3	177	245	115	218	228	179	2,920	465	620	50	9	55
4	180	245	115	223	213	179	1,700	500	597	50	9	90
5	180	245	115	223	229	238	1,300	483	717	48	10	40
6	230	245	115	231	238	238	2,420	483	730	52	11	52
7	275	245	115	237	237	237	5,170	450	550	49	12	60
8	293	140	115	238	237	237	2,640	435	427	44	12	58
9	275	142	125	238	235	237	2,210	435	427	58	13	48
10	230	172	125	238	235	237	5,400	405	322	34	92	42
11	200	200	125	238	235	237	1,980	405	418	32	20	78
12	185	172	125	238	235	237	1,640	390	405	31	59	61
13	185	230	125	179	235	237	1,420	366	295	36	49	63
14	185	230	125	206	235	237	1,320	470	295	30	88	52
15	185	230	125	206	235	237	1,240	470	290	30	60	88
16	185	200	125	188	235	237	1,150	470	215	30	44	100
17	185	125	125	188	235	237	840	530	190	35	40	149
18	210	125	125	233	208	240	770	530	180	33	35	35
19	245	117	125	238	181	241	630	530	155	31	115	135
20	245	117	125	238	235	225	490	530	155	26	61	138
21	245	117	125	240	238	331	480	550	155	25	35	147
22	245	117	125	131	235	1,300	465	457	155	25	25	135
23	245	117	125	215	235	810	450	392	140	17	27	150
24	245	117	125	229	235	1,270	450	982	140	15	27	143
25	245	117	125	240	235	934	465	982	125	11	29	143
26	245	117	125	238	235	407	465	890	125	12	26	145
27	245	117	125	238	235	344	465	575	112	13	26	182
28	245	117	125	237	235	344	613	547	112	9	23	136
29	245	117	125	238	....	565	965	487	112	9	33	142
30	245	117	125	206	....	1,480	615	547	112	8	31	165
31	245	....	125	206	....	1,220	....	547	....	12	26	....

NOTE.—Figures have been changed slightly to conform to computation rules of the U. S. Geol. Survey.

Monthly discharge of Belle Fourche River near Belle Fourche, S. Dak., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	293	177	223	13,700
November	245	117	170	10,100
December	125	115	122	7,500
January	240	131	221	13,600
February	238	173	227	12,600
March	1,480	179	439	27,000
April	5,400	450	1,560	92,800
May	982	366	524	32,200
June	730	112	312	18,600
July	58	8	30.9	1,900
August	115	9	34.4	2,120
September	182	25	99.6	5,930
The year	5,400	8	329	238,000

WHITE RIVER BASIN.

WHITE RIVER NEAR INTERIOR, S. DAK.

LOCATION.—Near southwest corner of sec. 7, T. 4 S., R. 18 E., at boundary of Pine Ridge Indian Reservation, at steel highway bridge 3 miles southwest of Interior, on line between Jackson and Pennington counties.

DRAINAGE AREA.—4,090 square miles.

RECORDS AVAILABLE.—August 24, 1911, to September 30, 1917; June 24, 1904, to November 30, 1906, at the original station in sec. 10, T. 4 S., R. 18 E.

GAGE.—A vertical staff attached to downstream side of first pier at left end of highway bridge; read by George Carlbom.

DISCHARGE MEASUREMENTS.—Made from highway bridge or by wading.

CHANNEL AND CONTROL.—Silt and sand, changing gradually.

EXTREMES OF DISCHARGE.—Maximum stage during year, 11.8 feet at 5 p. m. March 23, caused by ice jams; maximum discharge, at 7.7 feet March 30 (discharge, 3,260 second-feet); minimum stage, 3.2 feet August 5 and September 8–13 (discharge, 8 second-feet).

1914–1906 and 1911–1917: Maximum stage recorded, 16 feet March 8, 1905 (discharge, 16,500 second-feet); channel reported dry July 13–15, 19–29, September 26 to October 4, 1914.

ICE.—Stage-discharge relation seriously affected by ice.

DIVERSIONS AND REGULATION.—No diversions or storage reservoirs above are sufficiently great to noticeably affect the flow.

ACCURACY.—Stage-discharge relation changed slightly. Rating curves used October 1 to November 11 and March 28 to September 30 fairly well defined. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records fair.

Discharge measurements of White River near Interior, S. Dak., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 21	T. M. Wardwell	3.72	57	June 17	Alf Hulteng	4.10	156
Apr. 8	L. B. Dale	4.59	262	July 22	E. F. Chandler	3.62	41.8
May 19	Alf Hulteng	4.18	136	Aug. 18	do	3.44	16.8

Daily discharge, in second-feet, of White River near Interior, S. Dak., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	42	108		1,100	890	806	90	18	12
2	42	94		1,030	610	530	116	18	12
3	42	40		1,100	1,100	457	146	18	12
4	42	94		1,030	1,180	300	146	18	12
5	42	81		890	890	390	116	8	12
6	56	81		640	760	435	103	28	12
7	59	81		368	345	322	90	34	12
8	59	81		345	530	480	68	90	8
9	42	81		300	435	480	68	59	8
10	42	81		279	210	368	50	31	8
11	42	42		292	210	279	50	26	8
12	42			300	258	226	50	26	8
13	42			279	890	226	50	36	8
14	42			258	1,260	146	50	36	15
15	81			345	505	146	59	26	31
16	59			390	300	146	59	36	22
17	59			1,350	146	90	59	31	26
18	42			1,350	180	90	59	26	480
19	59			2,500	146	90	59	18	457
20	81			1,030	890	90	59	18	180
21	81			258	1,980	90	59	18	131
22	81			368	2,360	90	15	26	89
23	81			300	1,540	90	90	43	59
24	81			368	1,540	116	43	43	68
25	94			322	2,500	116	26	36	90
26	94			300	2,790	116	26	18	79
27	94			345	1,540	116	18	18	54
28	94		1,980	1,030	1,540	198	18	18	39
29	81		3,260	1,030	1,100	131	18	18	36
30	94		3,260	1,180	760	90	18	15	31
31	94		1,540		700		18	12	

Monthly discharge of White River near Interior, S. Dak., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	94	42	65.0	3,940
April	2,500	258	689	41,000
May	2,790	146	970	59,700
June	530	90	232	13,800
July	146	15	61.2	3,760
August	90	8	27.9	1,720
September	480	8	66.4	3,950

WHITE RIVER NEAR WESTOVER, S. DAK.

LOCATION.—In sec. 32, T. 3 S., R. 29 E., at boundary of Rosebud Indian Reservation, at steel highway bridge near Westover, 2 miles below mouth of South Fork of White River, 12 miles south and slightly east of Murdo, on Chicago, Milwaukee & St. Paul Railway.

DRAINAGE AREA.—7,850 square miles.

RECORDS AVAILABLE.—August 25, 1911, to September 30, 1917.

GAGE.—Chain gage attached to steel highway bridge; read by E. F. Sterner. Vertical staff gage with same datum as chain gage is bolted to concrete abutment of bridge, left bank. During 1911 the gage was a vertical staff on the left bank about 40 rods downstream from the present location, and its datum was such as to make readings about 2 feet greater than from the present gage.

DISCHARGE MEASUREMENTS.—Made from the highway bridge.

CHANNEL AND CONTROL.—Sand, silt, and quicksand; scours and shifts suddenly.

EXTREMES OF DISCHARGE.—Maximum stage during year, 15.1 feet at 8 p. m. March 22 (stage-discharge relation affected by ice); minimum stage, 6.2 feet July 30 (discharge, 85 second-feet).

1911–1915: Maximum stage recorded, 13 feet April 4, 1915 (discharge, 15,200 second-feet); minimum stage, 5.3 feet October 15, 1911 (discharge, 14 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

DIVERSIONS AND REGULATIONS.—No diversions or storage reservoirs above large enough to noticeably affect flow.

ACCURACY.—Stage-discharge relation not permanent. Gage read to half-tenths once daily. Discharge determined by shifting-control method. Records fair.

Discharge measurements of White River near Westover, S. Dak., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	Sec.-ft.			Feet.	Sec.-ft.
Oct. 20	T. M. Wardwell	6.71	176	June 16	Alf Hulteng	7.31	463
Apr. 7	L. B. Dale	8.44	1,386	July 21	E. F. Chandler	6.57	130
May 18	Alf Hulteng	7.58	747	Aug. 21	do	6.53	124

Daily discharge, in second-feet, of White River near Westover, S. Dak., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	97	200	....	3,310	1,900	2,060	262	105	95
2	97	200	....	2,920	1,610	1,750	250	110	95
3	103	200	....	2,060	1,540	1,750	240	118	95
4	103	200	....	1,750	1,470	2,390	215	105	95
5	105	200	....	1,540	2,920	1,980	215	100	95
6	107	200	....	1,470	2,300	1,680	232	118	95
7	117	200	....	1,470	1,680	1,400	335	118	95
8	117	200	....	1,140	1,260	1,400	270	118	95
9	125	172	....	740	1,140	1,260	232	110	95
10	132	172	....	650	1,010	1,260	232	105	95
11	132	140	....	610	695	1,140	200	118	95
12	132	125	....	535	549	1,140	191	118	95
13	132	125	....	500	500	895	160	132	95
14	137	125	....	500	412	695	150	130	95
15	140	125	....	458	385	594	150	118	108
16	150	....	....	470	2,220	500	140	118	100
17	160	....	....	740	1,070	482	140	118	97
18	160	....	....	1,540	740	412	140	118	95
19	160	....	....	2,220	650	396	140	150	95
20	172	....	....	1,750	570	385	140	120	95
21	172	....	....	1,680	650	360	125	118	160
22	172	....	....	1,900	2,390	345	135	118	470
23	172	....	....	1,540	3,110	335	140	115	270
24	172	....	....	1,010	2,740	312	125	107	200
25	185	....	....	790	2,920	312	110	103	180
26	200	....	....	610	7,900	312	105	97	160
27	200	....	....	570	8,250	312	95	95	156
28	200	....	3,770	610	4,610	299	95	95	140
29	200	....	3,310	535	3,110	312	87	95	140
30	200	....	3,770	2,480	2,560	312	85	107	140
31	200	....	4,310	....	2,560	....	97	97	....

NOTE.—Ice effect Nov. 16 to Mar. 27; data inadequate for determination of discharge.

Monthly discharge of White River near Westover, S. Dak., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	200	97	150	9,[illegible]
April	3,310	458	1,270	75,[illegible]
May	8,250	385	2,110	130,[illegible]
June	2,390	299	893	53,[illegible]
July	335	85	169	10,[illegible]
August	150	95	113	6,9[illegible]
September	470	95	131	7,[illegible]

SOUTH FORK OF WHITE RIVER NEAR WESTOVER, S. DAK.

LOCATION.—In NE. ¼ sec. 15, T. 43 N., R. 28 W., on Rosebud Indian Reservation, near house of observer, Mrs. C. H. Kendall, 2 miles above mouth of stream, 4 miles south of Westover, and 16 miles south of Murdo.

DRAINAGE AREA.—1,590 square miles.

RECORDS AVAILABLE.—June 26, 1912, to September 30, 1917.

GAGE.—Chain gage on projecting timber, on right bank 5 rods below cable. In 1912 and 1913, vertical staff gages at the same datum and nearly the same location were used.

DISCHARGE MEASUREMENTS.—Made from cable or by wading.

CHANNEL AND CONTROL.—Sandy and shifting.

EXTREMES OF DISCHARGE.—Maximum stage during year, 7.1 feet at 6 p. m., March 22, caused by ice jam; minimum discharge, 30 second-feet, September 30.

1912–1917: Maximum discharge recorded at 2.75 feet April 7, 1915 (discharge, 2,780 second-feet); minimum discharge, 20 second-feet, October 21, 1914.

ICE.—Stage-discharge relation seriously affected by ice; flow estimated from observer's reports and records of temperature and precipitation.

DIVERSIONS AND REGULATION.—No known diversions or storage reservoirs above are large enough to noticeably affect the flow.

ACCURACY.—Stage-discharge relation not permanent. Gage read daily to half-tenths. Discharge determined by shifting-control method. Records roughly approximate.

Discharge measurements of South Fork of White River near Westover, S. Dak., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 20	T. M. Wardwell	2.24	125	July 21	E. F. Chandler	1.92	75
Apr. 6	L. B. Dale	1.64	420	Aug. 20	....do	1.85	61
May 18	Alf Hulteng	1.98	271	21	....do	1.90	74
June 16	....do	2.09	242				

Daily discharge, in second-feet, of South Fork of White River, near Westover, S. Dak., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	56	124	....	730	344	236	81	48	62
2	62	124	....	730	428	203	81	48	62
3	62	124	....	570	428	176	81	48	62
4	62	148	....	520	428	148	90	48	48
5	62	148	....	453	386	148	100	74	48
6	48	148	....	386	344	148	90	100	48
7	48	148	....	386	306	148	81	110	48
8	74	148	....	365	306	269	81	100	56
9	100	148	....	344	306	176	81	100	59
10	81	148	....	306	216	150	62	124	34
11	81	124	....	269	216	124	62	148	34
12	81	124	....	269	203	124	62	114	34
13	81	100	....	269	220	124	62	81	42
14	81	....	....	306	236	124	62	81	48
15	81	....	....	288	203	124	62	62	42
16	81	....	....	269	223	236	62	48	42
17	48	....	....	269	203	148	62	48	42
18	64	....	....	344	203	124	62	48	48
19	81	....	....	520	203	124	62	48	62
20	119	....	....	474	236	124	62	48	34
21	81	....	....	520	203	112	62	73	34
22	96	....	....	474	203	100	81	62	34
23	110	....	....	428	203	81	62	62	34
24	100	....	....	386	203	90	48	62	34
25	100	....	....	428	570	100	48	62	34
26	100	....	....	361	1,500	100	48	62	34
27	100	....	1,260	284	520	100	48	62	34
28	100	....	730	428	176	100	48	62	34
29	112	....	850	386	176	100	48	62	34
30	124	....	850	344	176	100	48	62	30
31	124	....	730	....	206	....	48	62	....

Monthly discharge of South Fork of White River near Westover, S. Dak., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	124	48	83.8	5,160
April	730	269	404	24,000
May	1,500	176	315	19,400
June	269	81	139	8,250
July	100	48	65.7	4,040
August	148	48	71.6	4,400
September	62	30	43.0	2,560

PLATTE RIVER BASIN.

NORTH PLATTE RIVER NEAR NORTHGATE, COLO.

Location.—In sec. 11, T. 11 N., R. 80 W., at highway bridge on interstate highway 6 miles south of Colorado-Wyoming line and 6 miles northwest of Northgate, in Jackson County. Three small tributaries—Camp, Threemile, and Sixmile creeks—enter North Platte River between station and State line. These have very little flow except spring run-off.

Drainage area.—1,440 square miles (measured on Colorado typographic map, scale 1:500,000).

Records available.—May 23, 1915, to September 30, 1917.

Gage.—Chain gage installed on downstream side of bridge May 13, 1916; read by Mrs. H. L. McCasland. Original gage was a staff gage on middle pier of bridge at same datum.

Discharge measurements.—Made from two-span bridge or by wading.

Channel and control.—Bed composed of sand, gravel, and small boulders. Principal control of 200 feet downstream at small rapids; shifts occasionally. Banks not subject to overflow.

Ice.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

Extremes of discharge.—Maximum stage recorded during year, 6.0 feet on May 18 (discharge, 4,840 second-feet); minimum discharge occurred during winter.

Diversions.—There are court decrees for diversions of 3,060 second-feet from North Platte River and tributaries in Colorado. During 1917 Michigan ditch diverted 713 acre-feet from a tributary of the North Platte to the Cache la Poudre drainage basin between July 1 and September 8, 1917.

Regulation.—None.

Accuracy.—Stage-discharge relation not permanent; affected by ice during winter. Rating curve used October 1 to May 31, 1917, and curve used June 1 to September 30 are both fairly well defined between 200 and 3,500 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage heights to rating table, except for periods July 8 to 21, July 23 to August 9, and September 23 to 30, when there was no gage-height record and discharge was based on comparative hydrograph of North Platte at Saratoga. Records good, except for periods of missing gage heights and for discharges above 3,500 second-feet when they are fair.

Discharge measurements of North Platte River near Northgate, Colo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 21	H. K. Smith	1.96	407	Aug. 11	Robert Follansbee	2.25	500
June 15	Robert Follansbee	4.92	3,350	Sept. 18	S. B. Soulé	1.68	208
July 22	S. B. Soulé	3.17	1,310				

Daily discharge, in second-feet, of North Platte River near Northgate, Colo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	260	298	....	1,300	2,220	3,590	875	275
2	269	260	....	1,250	2,110	3,590	820	250
3	293	274	....	1,250	1,780	3,460	755	226
4	308	274	....	1,250	1,670	3,460	705	212
5	325	269	....	1,150	2,000	3,330	640	203
6	325	232	....	1,050	2,000	2,940	600	208
7	325	184	....	1,050	1,670	2,820	550	235
8	330	180	....	1,050	1,780	2,720	520	260
9	381	....	....	1,150	2,000	2,530	510	226
10	387	....	....	1,350	2,700	2,420	505	221
11	358	....	....	1,400	3,200	2,300	505	212
12	341	....	....	1,560	2,700	2,180	470	230
13	325	....	....	1,780	2,940	2,040	470	230
14	298	....	....	2,010	3,330	1,910	505	230
15	330	....	....	2,970	3,460	1,820	470	212
16	341	....	....	3,680	3,460	1,660	470	208
17	330	....	....	4,460	3,720	1,570	470	194
18	325	....	....	4,840	4,110	1,440	400	172
19	309	....	1,890	4,840	4,240	1,380	400	167
20	309	....	1,780	4,580	4,500	1,360	400	167
21	325	....	1,450	4,460	4,370	1,340	370	162
22	438	....	2,010	3,940	4,240	1,310	340	162
23	462	....	2,850	3,160	4,110	1,230	310	165
24	432	....	3,350	2,730	4,110	1,170	280	165
25	352	....	3,350	2,610	4,110	1,110	260	180
26	352	....	3,090	2,490	4,110	1,050	230	180
27	341	....	2,970	2,490	3,980	985	226	190
28	320	....	2,250	2,130	3,850	935	245	190
29	303	....	1,890	2,010	3,720	920	284	190
30	298	....	1,350	1,890	3,590	905	322	190
31	298	....	....	2,130	....	899	304	....

NOTE.—May 16–31, Sept. 1–22, discharge computed by indirect method for shifting control.

Monthly discharge of North Platte River near Northgate, Colo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	462	260	335	20,600
November 1–8	298	180	246	3,900
April 19–30	3,350	1,350	2,350	55,900
May	4,840	1,050	2,390	147,000
June	4,500	1,670	3,190	190,000
July	3,590	890	1,950	120,000
August	875	226	458	28,200
September	275	162	204	12,100

NORTH PLATTE RIVER AT SARATOGA, WYO.

LOCATION.—At highway bridge at Saratoga, Carbon County. Nearest tributary, Spring Creek, enters 2 miles above.

DRAINAGE AREA.—2,880 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—June 9, 1903, to October 31, 1906; April 1 to December 17, 1909; April 27, 1911, to October 31, 1912; April 1, 1915, to September 30,1917. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Chain gage on upstream side of bridge; read by Miss Nora Doggett and Miss Carrie Priquet. Original gage read prior to 1911 was vertical staff 100 yards below bridge. No determined relation between gages.

DISCHARGE MEASUREMENTS.—Made from two-span highway bridge or by wading near control.

CHANNEL AND CONTROL.—Bed composed of coarse gravel and small boulders. Control at rapids 500 feet downstream; fairly permanent. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.4 at 7 a. m. June 20 and 9 a. m. June 23 (discharge, 13,800 second-feet); minimum discharge 262 second-feet, January 19–24.

ICE.—Stage-discharge relation seriously affected by ice; flow estimated from discharge measurements, observer's notes, and temperature records.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 83 second-feet from the North Platte between Saratoga and State line.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice during winter. Rating curve well defined between 250 and 12,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent, except during period affected by ice when they are good.

Discharge measurements of North Platte River at Saratoga, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 24	H. K. Smith	4.55	734	May 16	H. W. Fear	7.69	7,840
Dec. 11	P. V. Hodges	a 4.40	359	June 14	Robert Follansbee	9.22	10,500
Jan. 10	H. K. Smith	a 4.38	359	July 20	S. B. Soulé	6.21	3,280
Feb. 11	....do	a 4.23	299	Sept. 20	....do	4.10	404

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of North Platte River at Saratoga, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	471	536	362	298	278	298	691	2,080	6,150	10,700	2,030	536
2	471	536	362	317	278	298	609	2,030	5,900	9,650	1,700	536
3	572	536	340	340	298	298	536	2,030	5,650	8,900	1,540	536
4	650	536	340	340	298	317	650	1,860	6,150	8,650	1,460	471
5	650	536	340	340	298	362	504	1,780	6,400	7,900	1,460	471
6	609	536	340	340	298	362	471	1,780	6,150	7,900	1,460	504
7	738	504	340	358	298	372	471	1,780	6,150	7,650	1,320	536
8	1,120	442	340	358	298	393	572	1,780	6,900	7,400	1,180	536
9	887	398	353	358	298	377	784	1,860	8,400	7,150	1,060	504
10	836	471	353	359	298	377	1,320	2,030	10,400	7,150	943	471
11	784	442	359	340	299	372	1,250	2,200	11,200	6,650	908	471
12	738	272	362	298	298	367	1,700	2,750	10,900	6,150	872	471
13	650	278	362	278	298	362	2,200	3,340	10,400	5,160	836	504
14	609	298	362	278	298	388	2,560	4,450	10,400	4,680	836	536
15	572	309	362	278	278	367	2,200	5,400	11,200	4,220	887	536
16	609	317	362	278	278	382	2,290	6,900	12,000	3,770	887	536
17	609	326	340	278	278	362	3,140	8,150	12,800	3,340	887	504
18	650	335	317	278	278	353	3,340	9,150	13,300	2,940	836	471
19	650	340	317	262	278	382	3,140	9,650	13,500	2,940	784	442
20	650	326	317	262	278	382	2,880	9,650	13,800	3,340	784	415
21	650	317	298	262	298	408	2,200	9,150	13,300	2,940	784	403
22	738	317	298	262	298	362	2,560	8,150	13,500	2,940	784	413
23	784	326	317	262	298	388	3,550	9,650	13,800	2,560	738	403
24	738	335	317	262	317	353	4,220	6,650	13,300	2,560	650	393
25	738	340	317	278	317	393	4,680	6,650	13,500	2,380	572	413
26	738	340	298	317	317	382	4,680	6,900	13,000	2,560	536	413
27	691	340	278	317	317	388	4,450	6,150	12,800	2,380	536	442
28	691	362	278	298	298	353	3,550	5,650	11,700	2,200	536	442
29	650	362	278	298	......	362	2,560	5,650	11,200	2,200	536	471
30	650	362	278	298	......	413	2,290	5,650	11,700	2,200	536	442
31	572	......	278	278	......	738	......	6,150	......	2,200	536	......

NOTE.—Nov. 13–Mar. 6, and Mar. 13 stage-discharge relation affected by ice. Discharge based on temperature and gage-height record, discharge measurements, and observer's notes. Aug. 11–12, Sept. 23, no gage-height record. Discharge interpolated.

Monthly discharge of North Platte River at Saratoga, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	1,120	471	683	42,000
November	536	272	389	23,100
December	362	278	328	20,200
January	359	262	302	18,600
February	317	278	295	16,400
March	738	298	378	23,200
April	4,680	471	2,180	130,000
May	9,650	1,780	5,060	311,000
June	13,800	5,650	10,500	625,000
July	10,700	2,200	4,950	304,000
August	2,030	536	949	58,400
September	536	393	474	28,200
The year	13,800	262	2,210	1,600,000

NORTH PLATTE RIVER ABOVE PATHFINDER, WYO.

LOCATION.—In sec. 27, T. 26 N., R. 84 W., 900 feet below mouth of Lost Creek and three-quarters of a mile below mouth of Black Canyon, Carbon County. Backwater from Pathfinder reservoir reaches within 2½ miles of station.

DRAINAGE AREA.—7,410 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—October 7, 1913, to September 30, 1917.

GAGE.—Friez water-stage recorder on right bank 900 feet below Lost Creek.

DISCHARGE MEASUREMENTS.—Made from cable at gage.

CHANNEL AND CONTROL.—Bed composed of small boulders. Gage at lower end of pool 600 feet long. Control located at rapids and is practically permanent. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder, 6.2 feet at 2 p. m. June 26 (discharge, 18,800 second-feet); minimum discharge occurs during winter when observations are discontinued.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 84 second-feet from North Platte River between Saratoga and the station above Pathfinder.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice during winter. Rating curve well defined between 300 and 17,000 second-feet. The operation of the water-stage recorder was satisfactory except for short intervals as explained in footnotes. Daily discharge ascertained by applying mean daily gage heights, determined by inspecting gage-height graph, to rating table. Records excellent, except for days of missing gage-heights, when they are fair.

Discharge measurements of North Platte River above Pathfinder, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	Sec.-ft.			Feet.	Sec.-ft.
Apr. 11	P. V. Hodges	3.84	6,030	July 24	S. B. Soulé	2.76	2,850
June 12	H. K. Smith	5.61	15,500				

Daily discharge, in second-feet, of North Platte River above Pathfinder, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	550	864		2,500	3,300	9,380	15,600	2,400	800
2	550	820		2,230	3,180	9,120	14,400	2,320	800
3	600	810		1,850	3,060	8,360	13,600	2,130	760
4	640	800		1,650	2,950	8,360	12,100	1,920	711
5	700	780		1,470	2,950	8,610	11,000	1,750	684
6	690	740		1,320	2,910	9,120	10,200	1,650	675
7	820	720		1,360	2,860	8,860	10,200	1,580	657
8	897	693		1,500	2,730	8,360	10,200	1,480	693
9	1,250	566		2,000	2,690	9,120	9,900	1,350	700
10	1,140	438		4,000	2,770	11,300	9,640	1,260	695
11	1,090	255		5,910	2,950	13,600	9,380	1,190	665
12	1,100			5,800	3,180	15,300	8,860	1,180	630
13	1,120			7,600	3,670	15,300	8,110	1,150	625
14	930			9,380	4,510	14,700	7,170	1,120	625
15	864			9,800	5,530	14,100	6,110	1,090	648
16	810			8,000	7,400	14,400	5,350	1,060	665
17	770			8,100	9,380	15,300	4,830	1,080	665
18	780	240		8,950	10,700	16,200	4,210	1,100	655
19	831			6,000	11,800	17,100	3,800	1,100	640
20	864			3,600	12,700	18,000	3,540	1,060	570
21	853			3,540	12,700	18,300	3,800	1,010	545
22	842			4,400	12,400	18,300	3,540	978	515
23	908			6,000	11,500	18,300	3,420	954	515
24	990			7,400	10,400	18,300	3,180	908	530
25	978			9,000	9,380	18,300	2,950	864	515
26	897			8,300	9,640	18,300	2,770	810	495
27	978			7,200	10,200	18,000	2,710	875	510
28	1,010			5,910	9,640	17,700	2,730	853	515
29	1,000			4,880	8,610	16,800	2,650	790	529
30	1,000			3,800	8,110	15,900	2,440	770	540
31	908		2,560		8,610		2,420	770	

NOTE.—Oct. 1-6, Apr. 8-10, 12-13, 15-20, 22-27, Sept. 9-14, 16-21, 23-28, 30, no gage-height record as water-stage recorder was out of order. Discharge based on comparative hydrograph of North Platte at Saratoga.

Monthly discharge of North Platte River above Pathfinder, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	1,250	550	883	54,300
November 1-11	864		681	14,900
April	9,800	1,320	5,110	304,000
May	12,700	2,690	6,850	421,000
June	18,300	8,360	14,100	839,000
July	15,600	2,420	6,800	418,000
August	2,400	770	1,240	76,200
September	800	495	626	37,200

NORTH PLATTE RIVER AT PATHFINDER, WYO.

LOCATION.—In sec. 24, T. 29 N., R. 84 W., a quarter of a mile below Pathfinder dam and one-third of a mile below old post office of Pathfinder, Natrona County. Nearest tributary, Canyon Creek, enters 2 miles above, in the reservoir.

DRAINAGE AREA.—10,700 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 9, 1905, to September 30, 1917.

GAGE.—Chain gage on left bank a quarter of a mile below Pathfinder dam; read by J. C. Austin.

DISCHARGE MEASUREMENTS.—Made from cable 50 feet above gage.

EXTREMES OF DISCHARGE.—No data.

WINTER FLOW.—Stage-discharge relation not seriously affected by ice.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 371 second-feet from tributaries entering the North Platte between the station above Pathfinder and this station. Near Whalen, 150 miles below, the water from Pathfinder reservoir is diverted by Interstate canal and used to irrigate land in Nebraska and Wyoming.

REGULATION.—The Pathfinder dam forms a reservoir 1,025,000 acre-feet in capacity, which materially changes the natural run-off of the river.

COOPERATION.—Records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of North Platte River at Pathfinder, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	750	5	5	5	5	5	5	1,000	5,350	17,400	5,550	5,110
2	780	5	5	5	5	5	5	1,000	6,400	16,700	4,240	5,110
3	780	5	5	5	5	5	5	1,000	7,450	15,900	4,060	5,110
4	800	5	5	5	5	5	5	1,000	8,270	15,200	4,060	5,110
5	800	5	5	5	5	5	5	1,000	6,700	14,100	4,480	5,110
6	800	5	5	5	5	5	5	1,000	7,300	13,100	4.560	5,110
7	660	5	5	5	5	5	5	1,000	8,200	12,100	5,730	5,140
8	750	5	5	5	5	5	5	1,000	8,670	11,400	5,730	5,110
9	850	5	5	5	5	5	5	1,000	8.860	10,800	5,730	5,110
10	955	5	5	5	5	5	5	1,000	9,320	10,400	5,730	5,110
11	1,290	5	5	5	5	5	5	1,580	10,200	10,200	4,380	4,240
12	1,290	5	5	5	5	5	5	2,000	11,600	9,820	4,060	4,040
13	230	5	5	5	5	5	5	2,050	13,200	9,400	4,060	4,040
14	5	5	5	5	5	5	5	2,050	14,400	8,860	4,060	4,180
15	5	5	5	5	5	5	5	2,120	15,000	8,230	4,060	4,060
16	5	5	5	5	5	5	5	2,020	14,800	8,490	4,060	4,060
17	5	5	5	5	5	5	5	2,060	15,000	8,410	4,060	4,060
18	5	5	5	5	5	5	5	2,020	15,200	8,350	4,060	4,060
19	5	5	5	5	5	5	5	2,040	16,000	8,200	4,060	4,060
20	5	5	5	5	5	5	5	2,060	16,900	8,090	4.060	4,060
21	5	5	5	5	5	5	5	2,020	17,800	7,780	4,060	3,200
22	5	5	5	5	5	5	5	480	18,300	5,620	4,060	3,070
23	5	5	5	5	5	5	5	10	18,600	4,760	4,140	3,070
24	5	5	5	5	5	5	800	10	18,800	4.560	4,060	3,120
25	5	5	5	5	5	5	960	10	18,900	4,540	4,060	3,070
26	5	5	5	5	5	5	1,020	10	18,900	4,760	4,060	3,070
27	5	5	5	5	5	5	1,020	10	18,900	4,680	4,060	3,070
28	5	5	5	5	5	5	1.020	20	18,800	4,590	4,850	2,260
29	5	5	5	5	....	5	990	1,970	18,600	4,560	5,130	2,140
30	5	5	5	5	....	5	990	3,030	18,100	4,560	5,110	2,140
31	5	....	5	5	....	5	....	4,120	....	4,560	5,110	....

NOTE.—Figures have been changed slightly to conform to computation rules of United States Geological Survey.

Monthly discharge of North Platte River at Pathfinder, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	1,290	5	349	21,500
November	5	5	5	298
December	5	5	5	307
January	5	5	5	307
February	5	5	5	278
March	5	5	5	307
April	1,020	5	230	13,700
May	4,120	10	1,340	82,400
June	18,900	5,350	13,500	803,000
July	17,400	4,540	9,040	556,000
August	5,730	4,060	4,500	277,000
September	5,140	2,140	4,010	239,000
The year	18,900	5	2,750	1,990,000

NORTH PLATTE RIVER NEAR CASPER, WYO.

Location.—In sec. 31, T. 32 N., R. 81 W., at highway bridge at Speas ranch, half a mile below Bessemer Canyon, in Natrona County. Nearest tributary, Bates Creek, enters 3 miles upstream.

Drainage area.—Not measured.

Records available.—April 9 to September 30, 1917.

Gage.—Vertical staff.

Discharge measurements.—Made from bridge.

Channel and control.—Channel apparently permanent. Control below bridge.

Diversions.—Prior to December 31, 1916, there were no approved diversions from North Platte River between station and Pathfinder reservoir.

Regulation.—(See North Platte at Pathfinder.)

Cooperation.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of North Platte River near Casper, Wyo., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	......	1,170	5,380	17,300	4,180	4,750	16	460	2,420	14,900	8,980	4,140	4,110
2	......	1,180	6,580	16,900	4,250	4,730	17	430	2,440	15,700	8,810	4,100	3,990
3	......	1,180	7,660	16,700	4,190	4,780	18	420	2,380	16,500	8,540	4,160	3,970
4	......	1,160	8,160	15,200	4,270	4,780	19	430	2,330	16,800	8,500	4,100	3,970
5	......	1,160	6,930	14,400	4,650	4,750	20	400	2,390	17,500	8,100	3,920	3,910
6	......	1,170	7,980	13,200	4,880	4,370	21	390	2,360	18,100	7,440	4,060	3,210
7	......	1,160	8,670	11,800	5,370	4,870	22	375	770	17,900	5,800	4,110	3,170
8	......	1,140	9,160	11,300	5,430	4,720	23	540	530	18,900	5,260	4,140	3,090
9	560	1,160	9,160	10,800	5,430	4,720	24	1,020	510	19,200	4,650	4,060	3,280
10	600	1,140	9,500	10,600	5,370	4,400	25	1,260	530	19,200	5,010	4,040	3,170
11	470	1,440	10,500	10,400	4,270	4,690	26	1,300	570	19,200	5,070	4,100	3,160
12	500	2,020	11,600	9,950	4,230	4,140	27	1,250	530	19,200	4,730	4,100	3,140
13	540	2,150	12,400	9,420	4,160	3,990	28	1,180	500	19,200	4,310	4,160	2,410
14	530	2,240	13,200	9,280	4,160	4,140	29	1,180	2,150	18,900	4,720	4,750	2,390
15	500	2,410	14,000	8,810	4,160	3,990	30	1,150	3,290	18,500	4,750	4,850	2,390
							31	.....	4,210	....	4,930	4,750	....

Monthly discharge of North Platte River near Casper, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 9-30	1,300	375	704	30,700
May	4,210	500	1,610	99,600
June	19,200	5,380	13,700	815,000
July	17,300	4,310	9,200	566,000
August	5,430	3,920	4,400	271,000
September	4,870	2,390	3,910	233,000
The period	....	....	....	2,010,000

Note.—Figures have been changed slightly to conform to computation rules of United States Geological Survey.

NORTH PLATTE RIVER AT McKINLEY, WYO.

Location.—About in sec. 21, T. 31 N., R. 69 W., at highway bridge at McKinley, in Converse County. Nearest tributary, Elkhorn Creek, enters several miles below.

Drainage area.—Not measured.

Records available.—April 1 to September 30, 1917.

Gage.—Vertical staff.

Discharge measurements.—Made from bridge.

Diversions.—Prior to December 31, 1916, adjudicated diversions of 53 second-feet from North Platte River between Casper station and McKinley.

Regulation.—(See North Platte River at Pathfinder.)

Cooperation.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of North Platte River at McKinley, Wyo., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,330	2,040	7,200	19,200	5,010	4,820
2	1,920	2,180	7,860	18,400	4,770	4,820
3	1,920	2,180	8,720	16,000	4,770	4,820
4	1,800	2,180	11,100	15,600	4,770	4,650
5	1,800	2,180	12,000	15,200	4,340	4,650
6	1,920	2,180	10,300	14,600	4,340	4,650
7	1,920	2,180	9,950	13,600	4,770	4,650
8	2,040	2,180	10,300	12,900	5,540	4,200
9	2,040	2,180	10,700	12,600	5,540	4,650
10	2,040	2,180	10,700	12,200	5,540	4,650
11	1,920	2,330	11,100	12,200	5,540	4,650
12	1,690	2,810	12,000	11,600	4,770	4,650
13	1,560	3,700	12,500	11,600	4,340	4,200
14	1,560	3,910	13,200	11,600	4,340	4,200
15	1,380	4,340	13,900	11,600	4,140	4,200
16	1,380	4,770	14,600	11,600	4,140	4,200
17	1,290	5,540	15,600	9,900	4,140	4,200
18	1,290	4,770	16,000	8,520	4,140	4,050
19	1,380	4,560	16,000	7,100	4,140	4,050
20	1,380	6,520	16,700	5,940	4,340	4,050
21	1,290	6,880	17,100	5,680	4,140	4,050
22	1,470	6,160	17,400	5,300	4,140	3,940
23	1,560	4,650	19,200	5,540	4,050	3,610
24	2,040	4,050	19,500	5,010	4,200	3,520
25	2,490	3,940	19,900	5,010	4,200	3,440
26	2,810	5,200	19,900	5,010	4,340	3,440
27	2,640	5,000	20,300	5,010	4,200	3,440
28	2,490	5,000	19,900	5,010	4,050	3,350
29	2,180	5,440	19,900	5,260	4,200	3,350
30	2,330	5,440	19,500	5,260	4,820	3,350
31	....	6,830	....	5,010	4,820	....

Monthly discharge of North Platte River at McKinley, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April	2,810	1,290	1,860	111,000
May	6,880	2,040	3,980	245,000
June	20,300	7,200	14,400	857,000
July	19,200	5,010	9,970	613,000
August	5,540	4,050	4,530	279,000
September	4,820	3,350	4,150	247,000
The period	....	....	....	2,350,000

Note.—Figures have been changed slightly to conform to computation rules of United States Geological Survey.

NORTH PLATTE RIVER ABOVE AND BELOW WHALEN, WYO.

Location.—In sec. 11, T. 26 N., R. 65 W., at diversion dam at Whalen, Goshen County. Nearest important tributary is Cottonwood Canyon Creek, an intermittent stream, which enters 1½ miles below.

Drainage area.—16,300 square miles (measured on base map of Wyoming; scale, 1:500,000).

Records available.—May 1, 1909, to September 30, 1917. Prior to October 1, 1916, the combined flow of the river and Interstate canal was given, and in addition, the flow through the Interstate canal. Beginning October 1, 1916, the flow above Whalen is given, which represents the flow of river and Interstate canal combined. The flow below Whalen represents the flow in the river passing the dam (overfall weir) below the Interstate canal diversion. The difference in the two records represents the amount diverted.

Gage.—To determine the flow over the weir a vertical staff is used, its zero being at the weir crest. The discharge is then computed by a weir formula. There are also four sluice gates in the dam, through which the discharge is computed. In the river, 75 feet downstream from the weir gage, is another, with zero 10 feet lower. The second gage is only used in computing the discharge through the gates when the openings are submerged. The discharge through the head gates of the canal is computed from the nine gate openings. A vertical staff located in the canal 1,000 feet below the head gates is used in computing the discharge when the head-gate openings are submerged.

Discharge measurements.—Made from cable 1 mile below weir in order to check the coefficients used in the discharge computations.

Diversions.—Prior to December 31, 1916, there were adjudicated diversions from North Platte River of 32 second-feet between McKinley and the Whalen gaging station, exclusive of the diversion by the United States Reclamation Service. Between Whalen and the State line there are adjudicated diversions of 240 second-feet.

Regulation.—Records show the flow as regulated by Pathfinder reservoir, which stores water for use in the Interstate canal.

Cooperation.—Records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of North Platte River above Whalen, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,060	242	275	150	170	500	2,110	2,160	8,800	19,700	4,660	4,960
2	1,650	234	290	150	180	500	1,940	2,240	9,420	19,000	4,720	5,000
3	1,460	234	280	150	170	525	1,480	2,320	9,680	18,100	5,540	5,010
4	1,510	223	270	150	160	550	828	2,260	10,600	17,500	4,380	5,000
5	1,530	230	290	160	160	550	794	2,290	13,100	16,600	4,360	5,000
6	1,510	227	280	170	160	550	590	2,480	13,700	15,600	4,360	5,000
7	1,440	223	190	170	160	575	515	2,360	10,900	13,800	4,700	5,060
8	1,360	184	190	170	160	575	400	2,300	11,000	12,600	4,720	5,040
9	1,370	193	170	170	170	575	550	2,280	11,500	11,300	5,420	5,460
10	1,300	165	180	170	170	575	488	2,270	11,600	10,500	5,420	5,010
11	1,210	143	170	180	175	575	564	2,240	11,700	10,000	5,480	5,010
12	1,210	148	180	170	180	575	629	2,340	12,000	9,660	5,420	5,010
13	1,270	148	190	180	180	575	737	2,630	12,800	9,400	4,480	4,290
14	1,540	80	190	180	180	590	884	3,920	14,400	9,120	4,380	4,150
15	1,210	93	180	170	190	600	880	4,460	15,600	8,800	4,260	4,160
16	1,110	93	180	180	190	600	936	5,170	16,200	8,500	4,240	4,180
17	1,020	124	190	180	190	600	850	6,050	16,800	8,460	4,220	4,180
18	856	178	190	190	200	600	950	6,350	17,400	8,360	4,240	4,140
19	888	277	200	190	200	600	900	5,760	17,200	8,480	4,240	4,140
20	692	277	190	190	200	600	1,110	6,350	16,800	8,220	4,410	4,100
21	500	277	180	180	220	600	1,670	6,830	17,600	7,950	4,400	3,990
22	500	277	180	140	240	600	1,380	7,690	18,600	7,820	4,230	3,780
23	500	302	170	150	250	600	1,940	6,830	19,600	7,430	4,170	3,640
24	573	327	170	160	270	650	2,110	5,790	20,000	5,450	4,190	3,290
25	550	405	170	160	300	650	2,460	4,770	20,300	5,220	4,190	3,230
26	548	377	160	170	350	750	2,880	5,660	20,600	4,860	4,180	3,340
27	450	321	150	170	450	800	3,030	7,480	20,800	4,810	4,160	3,370
28	346	293	150	180	450	850	2,840	6,900	21,000	4,910	4,200	3,300
29	340	247	150	190	....	1,040	2,520	7,320	21,000	4,810	4,230	3,240
30	325	233	140	190	....	1,580	2,220	7,760	20,700	4,960	4,730	2,900
31	280	....	150	190	....	1,550	....	7,600	....	4,860	5,010	....

Daily discharge, in second-feet, of North Platte below Whalen, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,610	242	275	150	170	500	2,110	1,540	7,940	18,200	3,040	3,350
2	1,380	234	290	150	180	500	1,940	1,550	8,560	17,500	3,100	3,360
3	1,460	234	280	150	170	525	1,480	1,540	8,830	16,600	3,910	3,380
4	1,510	233	270	150	160	550	828	1,490	9,700	16,000	2,760	3,360
5	1,530	230	280	160	160	550	794	1,510	12,300	15,000	2,740	3,360
6	1,510	227	280	170	160	550	590	1,660	12,800	14,100	2,740	3,360
7	1,440	223	190	170	160	575	515	1,540	10,000	12,300	3,070	3,800
8	1,360	184	190	170	160	575	400	1,490	10,400	11,000	3,100	3,700
9	1,370	193	170	170	170	575	550	1,460	10,900	9,780	3,800	4,070
10	1,300	165	180	170	170	575	488	1,440	11,000	8,940	3,800	3,620
11	1,210	143	170	180	175	575	564	1,410	11,000	8,470	3,850	3,520
12	1,210	148	180	170	180	575	629	1,490	11,300	8,110	3,800	3,520
13	1,270	148	190	180	180	575	737	1,780	12,100	7,850	2,860	2,800
14	1,320	80	190	180	180	590	884	3,040	13,700	7,560	2,760	2,660
15	1,210	93	180	170	190	600	880	3,550	14,600	7,240	2,640	2,660
16	1,110	98	180	180	190	600	936	4,250	15,000	6,940	2,610	2,680
17	1,020	124	190	180	190	600	850	5,120	16,000	6,900	2,600	2,680
18	856	178	190	190	200	600	950	5,400	16,800	6,800	2,620	2,740
19	708	277	200	190	200	600	900	4,810	16,500	6,900	2,610	2,740
20	277	277	190	190	200	600	1,110	5,400	15,600	6,620	3,010	2,740
21	0	277	180	180	220	600	1,670	5,880	16,300	6,350	2,880	2,590
22	0	277	180	140	240	600	1,380	6,740	17,200	6,220	2,660	2,490
23	0	302	170	150	250	600	1,410	5,880	18,200	5,830	2,600	2,380
24	183	327	170	160	270	650	1,510	4,830	18,600	3,850	2,580	2,030
25	265	405	170	160	300	650	1,780	3,850	18,900	3,620	2,580	2,030
26	548	377	160	170	350	750	2,380	4,810	19,100	3,260	2,570	2,140
27	450	321	150	170	450	800	2,490	6,620	19,300	3,210	2,530	2,170
28	346	293	150	180	450	850	2,310	6,050	19,500	3,310	2,570	2,100
29	340	247	150	190	....	1,040	1,960	6,470	19,500	3,210	2,600	2,290
30	325	233	140	190	....	1,580	1,630	6,900	19,100	3,330	3,100	1,960
31	280	....	150	190	....	1,550	....	6,740	....	3,230	3,380	....

NOTE.—Figures have been changed slightly to conform to computation rules of the United States Geological Survey.

Monthly discharge of North Platte River above Whalen, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	2,060	280	1,000	61,500
November	405	80	226	13,400
December	290	140	195	12,000
January	190	140	171	10,500
February	450	160	217	12,100
March	1.580	500	679	41,800
April	3,030	400	1,370	81,500
May	7,760	2,160	4,610	283,000
June	21,000	8,800	15,400	916,000
July	19,700	4,810	9,900	609,000
August	5,540	4,160	4,560	280,000
September	5,460	2,900	4,270	251,000
The year	21,000	80	3,560	2,570,000

Monthly discharge of North Platte River below Whalen, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	1,610	0	884	54,400
November	405	80	226	13,400
December	290	140	195	12,000
January	190	140	171	10,500
February	450	160	216	12,100
March	1,580	500	679	41,800
April	2,490	400	1,220	72,600
May	6,900	1,410	3,750	231,000
June	19,500	7,940	14,400	857,000
July	18,200	3,210	8,330	512,000
August	3,850	2,530	2,950	181,000
September	4,070	1,960	2,890	171,000
The year	19,500	0	3,000	2,170,000

BIG CREEK NEAR BIG CREEK, WYO.

LOCATION.—In sec. 32, T. 13 N., R. 81 W., at Big Creek ranger station, 2 miles west of Big Creek post office, Carbon County. No important tributary within several miles.

DRAINAGE AREA.—123 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 7, 1911, to June 30, 1912; April 4, 1915, to September 18, 1917. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Vertical staff on left bank 50 feet from ranger station; read by J. C. Peryam. Prior to April 29, 1915, gage was placed 1 foot farther out in the stream and gave readings slightly different although referred to same datum.

DISCHARGE MEASUREMENTS.—Made from bridge a quarter of a mile below gage or by wading at gage.

CHANNEL AND CONTROL.—Bed composed of coarse gravel and small boulders. Control at gage, which is on riffle; permanent during 1917. Right bank subject to overflow at stage of 4.2 feet; left bank high. Stage of zero flow, 0.6 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.1 feet at 7 p. m., July 1 (discharge, 985 second-feet); minimum discharge probably occurs during winter.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

DIVERSIONS.—Prior to December 31, 1916, there were no adjudicated diversions from Big Creek above the station in Wyoming, but below the diversions amount to 100 second-feet. In Colorado the Independence ditch diverts from Big Lake to the North Platte drainage basin approximately 80 second-feet, usually from June 10 to July 10 each year. Storage filing for 27,548 acre-feet in Big Lake which supplies Independence ditch.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice during winter. Rating curve well defined between 30 and 900 second-feet. Gage read to hundredths once or twice daily. Daily discharge ascertained by applying one daily gage reading or the mean of two daily gage readings to rating table. Records good, but fragmentary, owing to absence of observer.

Discharge measurements of Big Creek near Big Creek, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 21	H. K. Smith	1.74	60	July 22	S. B. Soulé	2.57	281
June 15	Robert Follansbee	3.69	774	Sept. 18	do	1.56	35.7

Daily discharge, in second-feet, of Big Creek near Big Creek, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	May.	June.	July.	Aug.	Sept.
1	37	34			985	164	
2	36	31	49		885	151	
3	51	30				128	
4	51	34				132	
5	33	33		478		122	
6	34	30	52	500		110	
7	44	30	49	545		120	
8	55		49	692	735	110	
9	51		52	838	685	106	
10	52		65	985	635	104	
11	52		88	885	635	92	
12	47		120	835	635		
13	42		196	785			
14	42		370	835		82	
15	42		410	785	410	88	
16	42		545	432	350		
17	41		522		350		
18	41		522		330		37
19	48		522		330		
20	58		478				
21	60		330				
22	48		330		284	74	
23	49		370			57	
24	55		410				
25	58		330				
26	47		312				
27	41		330				
28	41		432				
29	39		421				
30	39		410				
31	36						

Monthly discharge of Big Creek near Big Creek, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	60	33	45.5	2,800
November 1-7	34	30	31.7	440

FRENCH CREEK NEAR FRENCH, WYO.

Location.—In sec. 4, T. 14 N., R. 81 W., at Jenkins ranch, 3½ miles southeast of French, Carbon County. No tributary between station and mouth 2 miles below.

Drainage area.—64 square miles (measured on base map of Wyoming; scale, 1:500,000).

Records available.—April 30, 1911, to October 31, 1912; April 1, 1915, to September 30, 1917, when station was discontinued. State engineer maintained station at this point 1913 and 1914.

Gage.—Vertical staff on downstream end of heavy rock-filled crib on left bank, a quarter of a mile above head gate of French Creek Irrigation & Development Co's. canal; read by J. W. Jenkins and Miss Pearl Jenkins.

Discharge measurements.—Made from cable 75 feet above gage or by wading.

Channel and control.—Bed composed of small boulders; control 30 feet downstream; shifting occasionally. Banks not subject to overflow.

Extremes of discharge.—Maximum stage recorded during year, 4.1 feet at 6 p. m. June 24 (discharge, 1,240 second-feet); minimum stage occurs during winter.

Ice.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

Diversions.—Prior to December 31, 1916, there were no adjudicated diversions from French Creek above station, but below station there are diversions of 4 second-feet. From North French Creek there are adjudicated diversions of 6 second-feet.

Regulation.—None.

Accuracy.—Stage-discharge relation not permanent; affected by ice during winter. Rating curve used October 1 to November 11 well defined between 20 and 300 second-feet. Curve used March 16 to September 30 not well defined. Gage read to hundredths twice daily. Daily discharge ascertained by applying the mean daily gage height to rating table. Records good up to 600 second-feet, above which they are fair.

Discharge measurements of French Creek near French, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Oct. 22	H. K. Smith	1.35	21.9
July 23	S. B. Soulé	2.33	180
Sept. 19	....do	1.46	30.6

Daily discharge, in second-feet, of French Creek near French, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	17	20		17	24	131	755	115	41
2	22	20		19	23	131	658	103	40
3	27	20		19	24	141	592	96	40
4	27	18		20	24	155	560	91	38
5	27	18		17	24	160	625	90	40
6	27	17		14	25	152	592	85	42
7	37	17		14	25	152	560	81	42
8	36	17		14	25	220	530	74	40
9	29	17		17	26	310	500	71	38
10	26	17		17	28	385	440	71	34
11	25	17		19	41	360	412	73	38
12	24			21	42	360	385	68	40
13	23			20	56	360	360	66	38
14	22			20	83	385	360	66	35
15	21			17	111	440	310	66	33
16	21		18	17	141	530	262	68	32
17	20		18	17	160	592	240	65	31
18	20		18	17	170	690	220	66	30
19	20		18	16	170	790	220	65	28
20	24		17	17	185	825	240	63	28
21	24		14	20	165	895	197	62	28
22	22		14	27	141	965	188	59	27
23	20		12	34	148	965	176	55	27
24	20		12	39	155	965	170	52	27
25	23		11	40	155	1,040	168	50	27
26	24		12	39	137	965	165	44	30
27	24		12	33	121	895	148	71	29
28	22		12	31	127	825	139	62	28
29	20		16	29	138	895	139	48	28
30	20		17	28	143	825	143	46	28
31	20		17		152		139	42	

Monthly discharge of French Creek near French, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	37	17	23.7	1,460
November 1-11	20	17	18.0	393
March 16-31	18	11	14.9	473
April	40	14	22.3	1,330
May	185	23	96.3	5,920
June	1,040	131	550	32,700
July	755	139	342	21,000
August	115	42	68.8	4,230
September	42	27	33.6	2,000

ENCAMPMENT RIVER AT ENCAMPMENT, WYO.

LOCATION.—In sec. 6, T. 14 N., R. 83 W., at lower end of smelter grounds at Encampment, Carbon County. Nearest tributary, North Fork, enters 1 mile above.

DRAINAGE AREA.—219 square miles (measured on base map of Wyoming; scale, 1,500,000).

RECORDS AVAILABLE.—May 2, 1911, to October 31, 1912; May 29, 1915, to September 30, 1917. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Chain gage on left bank at tailing flume which crosses the river; read by Earl Waite. Prior to June 6, 1912, gage was 175 feet farther downstream, and although referred to same datum, read approximately 1 foot lower, owing to the slope of the river.

DISCHARGE MEASUREMENTS.—Made from cable 125 feet below gage or by wading.

CHANNEL AND CONTROL.—Channel composed of gravel and small boulders which shifted after the high water of 1917. Control is not well defined, though there are small rapids 200 feet downstream.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.9 feet at 6.30 p. m. June 23 (discharge, 4,490 second-feet); minimum discharge occurs during winter.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

DIVERSIONS.—Three large irrigation ditches divert water at a point 1 mile above station. The smelter company has a pipe line which diverts water above the station, but as the tailrace of the power plant, which the pipe line supplies is just above station, the amount diverted passes the gage. Water is also diverted below station. Prior to December 31, 1916, there were adjudicated diversions from Encampment River amounting to 76 second-feet.

REGULATION.—None.

ACCURACY.—Stage-discharge relation shifted during high water of 1917. Affected by ice during winter. Rating curve used October 1 to July 21 well defined between 40 and 3,500 second-feet; curve used July 22 to September 30 well defined between 50 and 800 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying the mean daily gage height to rating table. Records good, except for period June 15 to July 21 when, on account of shifting of stage-discharge relation, the records are only fair.

Discharge measurements of Encampment River at Encampment, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
June 14	Robert Follansbee	7.61	2,480
July 22	S. B. Soulé	5.45	539
Sept. 17	.....do	4.00	59

Daily discharge, in second-feet, of Encampment River at Encampment, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	72	123	....	166	805	1,810	296	62
2	76	114	....	166	840	1,680	240	62
3	121	101	....	160	1,260	1,580	194	59
4	190	93	....	144	1,010	1,590	188	53
5	163	86	....	133	920	1,590	210	57
6	184	73	....	133	1,010	1,480	182	59
7	220	63	....	157	1,060	1,670	171	67
8	290	61	....	166	1,310	1,860	154	77
9	420	59	....	163	2,600	1,620	165	79
10	580	55	....	166	3,950	1,520	133	82
11	525	....	....	190	3,500	1,290	126	75
12	398	....	....	205	3,050	1,190	110	65
13	310	....	....	220	2,750	1,100	110	62
14	220	....	....	272	2,900	1,020	126	65
15	205	....	133	375	3,820	856	112	61
16	184	....	114	470	3,080	791	112	62
17	166	....	107	580	2,930	728	97	61
18	136	....	89	840	3,240	670	128	75
19	136	....	105	1,200	3,260	616	116	59
20	109	....	126	1,200	3,560	983	116	62
21	91	....	146	1,100	3,420	688	106	62
22	89	....	155	1,100	4,040	600	86	67
23	80	....	190	1,010	4,340	515	79	62
24	86	....	238	1,010	3,750	515	84	47
25	79	....	255	920	3,170	770	80	49
26	75	....	255	840	3,170	515	95	53
27	75	....	290	805	2,880	490	79	59
28	73	....	255	770	2,600	442	79	53
29	81	....	184	700	2,320	419	77	49
30	91	....	160	735	2,050	419	75	47
31	105	....	....	805	....	375	72	....

NOTE.—June 15 to July 21, discharge computed by the indirect method for shifting control.

Monthly discharge of Encampment River at Encampment, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	580	72	182	11,200
November 1-10	123	55	82.8	1,640
April 15-30	290	89	175	5,550
May	1,200	133	545	33,500
June	4,340	805	2,620	156,000
July	1,860	375	1,010	62,100
August	296	72	129	7,930
September	82	47	61.7	3,670

JACK CREEK AT MATHESON RANCH, NEAR SARATOGA, WYO.

LOCATION.—About sec. 36, T. 17 N., R. 86 W., at Matheson ranch, 14 miles southwest of Saratoga, in Carbon County. Nearest tributary, North Jack Creek, enters some distance below.

DRAINAGE AREA.—32 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—August 23, 1913, to September 19, 1917.

GAGE.—Vertical staff at left abutment of wagon bridge 1,000 feet below ranch house; read by Miss Kathleen Montgomery. Gage originally 200 feet above present site; moved 800 feet farther upstream August 15, 1915 and used until June 13, 1917. No definite relation between readings on various gages.

DISCHARGE MEASUREMENTS.—Made from wagon bridge or by wading.

ANNEL AND CONTROL.—Channel composed of mud; control 100 feet downstream at small rapids which was practically permanent during 1917. Banks are overflowed at stage of 4.0 feet.

REMES OF DISCHARGE.—Maximum stage recorded during year, 4.3 feet June 11 (discharge, 260 second-feet); minimum discharge probably occurs during winter.

—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

ERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 9 second-feet from Jack Creek above station and 93 second-feet below.

ULATION.—None.

URACY.—Stage-discharge relation practically permanent; affected by ice during winter. Rating curve used October 1 to June 12 well defined between 5 and 100 second-feet; curve used June 13 to September 30 fairly well defined between 10 and 220 second-feet. Gage read to hundredths twice daily. Daily discharge ascered by applying mean daily gage height to rating table. Records good.

harge measurements of Jack Creek at Matheson ranch, near Saratoga, Wyo., during the year ending Sept. 30, 1917.

.e.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	Sec.-ft.			Feet.	Sec.-ft.
19..	H. K. Smith	1.78	8.4	July 20..	S. B. Soulé	b1.82	48
17..	H. W. Fear	3.63	156	Sept. 19.	.....do	c.72	6.1
13 .	Robert Follansbee	a3.69	208				

a Old gage read 3.98 feet. b Stage at old gage, 2.60 feet. c Stage at old gage, 1.63 feet.

OTE.—On June 13, 1917, gage was moved 1,000 feet downstream to the new highway bridge.

ily discharge, in second-feet, of Jack Creek at Matheson ranch, near Saratoga, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.
	7	8			91	190	33
	7	7			91	180	31
	8	9			119	180	25
	11	8			119	190	16
	11	10			113	180	19
	9	10		10	125	175	18
	17	9		9	182	180	16
	17			10	181	109	16
	12			10	174	113	
	11			9	196	109	
	14			14	212	106	
	10			12	244	93	
	11			28	210	97	
	9			34	240	85	
	11		47	62	240	76	
	9		32	132	240	70	
	12		23	145	240	47	
	12		18	152	240	47	
	11		25	166	260	39	
	14		21	196	260	40	
	11		20	196	260	38	
	13		19	196	240	35	
	11		23	196	250	33	
	10		20	138	240	29	
	11		26	138	240	31	
	10			145	230	29	
	10			196	230	27	
	10			196	210	23	
	10			132	210	27	
	11			113	210	38	
	8			96		31	

Monthly discharge of Jack Creek at Matheson ranch, near Saratoga, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	17	7	10.9	670
November 1-7	10	7	8.7	121
April 15-25	47	18	24.8	541
May 6-31	196	9	105	5,420
June	260	91	202	12,000
July	190	23	85.4	5,250
August 1-8	33	16	21.8	346

MEDICINE BOW RIVER NEAR MEDICINE BOW, WYO.

LOCATION.—In sec. 7, T. 20 N., R. 79 W., at private bridge at Johnson's ranch, 14 miles southwest of Medicine Bow, Carbon County. Nearest tributary, Wagonhound Creek, enters 3 miles below.

DRAINAGE AREA.—178 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—June 4, 1911, to November 30, 1912; May 5, 1915, to November 3, 1917. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Vertical staff on downstream side of left abutment; read by Mrs. S. W. Johnson. Gage used during 1911 and 1912 was 600 feet upstream and referred to different datum.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel. Control 75 feet downstream at riffle composed of gravel and small boulders well compacted; shifts occasionally. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.4 feet at 7.30 a. m. June 23 (discharge, 2,810 second-feet); minimum discharge probably occurs during winter.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 207 second-feet from Medicine Bow River above station and 67 second-feet below.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during winter. Rating curve used October 1 to November 11 well defined below 500 second-feet; curve used April 15 to November 3 well defined below 1,300 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent up to 1,300 second-feet; above this they are fair.

Discharge measurements of Medicine Bow River near Medicine Bow, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
June 17	Robert Follansbee	3.68	943	July 25	S. B. Soulé	2.04	92
28	H. K. Smith	3.87	1,230	Sept. 16	do	1.50	10.1

Daily discharge, in second-feet, of Medicine Bow River near Medicine Bow, Wyo., for the period Oct. 1, 1916, to Nov. 3, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	3	35	....	54	355	922	51	9	3.6	22
2	3	32	....	60	322	780	48	8	3.6	22
3	3	28	....	65	241	645	32	8	3.6	22
4	6	27	....	68	260	645	23	7	2.8	....
5	13	27	....	68	300	645	23	7	4.4	....
6	16	25	....	68	345	682	21	9	6.8	....
7	16	25	....	78	395	610	22	10	8.4	....
8	15	24	....	87	450	575	23	14	10	....
9	20	24	....	91	450	645	21	11	10	....
10	21	22	....	98	575	645	20	8	10	....
11	24	21	....	104	800	422	21	8	10	....
12	24	....	....	113	510	395	21	9	10	....
13	16	....	....	146	450	370	21	8	10	....
14	15	....	....	174	610	300	18	8	10	....
15	15	....	83	206	610	264	21	8	11	....
16	15	....	78	241	720	215	20	10	11	....
17	15	....	91	260	922	209	22	10	12	....
18	16	....	91	268	1,100	143	28	9	12	....
19	19	....	72	260	1,880	143	29	8	14	....
20	19	....	68	309	2,100	154	29	8	15	....
21	21	....	65	322	2,330	162	32	7	16	....
22	21	....	72	292	2,330	118	28	7	16	....
23	25	....	137	268	2,810	110	21	6	17	....
24	27	....	132	292	2,100	104	16	5	17	....
25	28	....	146	322	1,450	98	12	7	20	....
26	31	....	120	355	1,880	91	20	10	20	....
27	32	....	98	260	1,060	91	30	10	20	....
28	25	....	87	230	1,010	76	20	9	20	....
29	28	....	72	268	965	76	15	7	20	....
30	31	....	51	300	1,060	76	12	5	20	....
31	35	....	....	322	....	72	10	....	20	....

Monthly discharge of Medicine Bow River near Medicine Bow, Wyo., for the period Oct. 1, 1916, to Oct. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	35	3	19.3	1,190
November 1-11	35	21	26.4	576
April 15-30	146	51	91.4	2,900
May	355	54	195	12,000
June	2,810	241	1,010	60,100
July	922	72	338	20,800
August	51	10	23.5	1,440
September	14	5	8.3	494
October	20	2.8	12.4	762

ROCK CREEK NEAR ARLINGTON, WYO.

LOCATION.—In sec. 25, T. 19 N., R. 79 W., at highway bridge 1½ miles above Arlington, Carbon County. Nearest tributary, Overland Creek, enters half a mile above. Prior to January 12, 1916, station was at Arlington, 1½ miles downstream. Flow at two points practically the same.

DRAINAGE AREA.—70 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 22, 1911, to September 30, 1917.

GAGE.—Bristol water-stage recorder on left bank just below bridge.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed rough and composed of coarse gravel and small boulders. Control not well defined. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder 4.6 feet at 6 p. m. June 21 (discharge, 1,100 second-feet); minimum discharge, 4 second-feet on January 22 and 23.

ICE.—Stage-discharge relation seriously affected by ice; flow estimated from discharge measurements, observer's notes, and temperature records.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated permits for diversion of approximately 4 second-feet from Rock Creek above and 209 second-feet below the station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation shifting during year; shifting-control method used. Gage heights from continuous record. Daily discharge ascertained by applying to rating table mean daily gage height obtained by inspection. Records fair.

Discharge measurements of Rock Creek near Arlington, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 14	M. W. Gordon	0.96	21.5	Mar. 22	Ed. Lanning	0.93	10.1
Dec. 9	Ed. Lanning	1.08	13.9	Apr. 5	.....do	.94	17.2
22	.....do	1.1	9.26	May 11	.....do	.95	19.1
Jan. 10	.....do	1.15	15.5	July 8	.....do	2.90	450
Feb. 16	.....do	1.04	12.2	26	S. B. Soulé	1.60	137
Mar. 1	.....do	.83	6.03	Aug. 27	M. W. Gordon	.93	21.4
14	.....do	.90	9.30				

Daily discharge, in second-feet, of Rock Creek near, Arlington, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	20	16	25	8	8	6	18	18	67	509	92	14
2	19	16	25	10	10	6	16	18	92	490	74	15
3	18	19	24	12	11	7	16	18	106	490	67	14
4	18	20	22	14	12	10	16	18	127	490	56	13
5	19	21	21	15	13	11	17	13	131	490	50	14
6	23	22	22	15	13	12	18	12	138	490	48	20
7	30	21	18	15	13	12	18	13	154	490	45	23
8	31	20	16	15	13	12	21	13	178	453	44	19
9	27	19	14	15	13	12	27	13	271	441	41	18
10	26	18	14	16	13	12	27	13	380	337	40	16
11	27	16	14	15	13	11	23	17	351	395	39	17
12	25	16	14	13	13	10	21	18	300	265	34	18
13	24	15	14	11	13	9	24	18	265	247	32	19
14	23	14	15	9	12	9	30	22	309	230	29	20
15	23	15	15	8	12	9	35	36	433	208	26	20
16	23	16	15	7	12	8	27	42	737	200	26	19
17	22	16	16	7	11	9	27	51	832	170	27	18
18	22	18	16	6	10	10	25	68	870	149	28	18
19	21	18	15	5	9	10	19	74	940	172	27	19
20	21	19	13	5	9	10	19	82	946	200	28	19
21	22	19	11	5	10	10	18	68	965	182	25	19
22	23	19	9	4	11	10	18	59	1,000	158	24	20
23	23	20	10	4	11	10	18	65	813	166	23	21
24	24	20	11	5	11	10	18	72	699	147	20	21
25	21	20	10	6	12	10	18	70	661	142	20	21
26	20	22	9	8	10	9	18	58	623	133	21	23
27	20	23	8	8	9	12	18	51	661	127	21	27
28	20	23	7	9	8	16	18	58	699	116	18	24
29	20	24	7	10	......	20	18	58	642	116	18	27
30	19	25	6	10	......	25	18	62	628	108	18	25
31	19	......	6	9	......	23	......	58	......	106	14	......

NOTE.—Stage-discharge relation affected by ice Nov. 8-28, Dec. 8 to Mar. 27, Apr. 2-6; discharge based on measurements, gage heights, and temperature records. No gage heights Oct. 15-19, Apr. 22 to May 1, Sept. 18 and 19; discharge interpolated.

Monthly discharge of Rock Creek near Arlington, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	31	18	22.4	1,380
November	25	14	19.0	1,130
December	25	6	14.3	879
January	16	4	9.7	596
February	13	8	11.2	622
March	25	6	11.3	695
April	35	16	20.8	1,240
May	82	12	40.5	2,490
June	1,000	67	501.	29,800
July	509	106	273.	16,800
August	92	14	34.7	2,130
September	35	13	19.7	1,170
The year	1,000	4	81.4	58,900

DEEP CREEK NEAR ARLINGTON, WYO.

LOCATION.—In sec. 16, T. 17 N., R. 79 W., at outlet of Sand Lake, 12 miles northwest of Arlington, in Carbon County, at an elevation of 10,100 feet. No tributary within several miles.

DRAINAGE AREA.—3.7 square miles (measured on topographic map).

RECORDS AVAILABLE.—July 30, 1914, to September 30, 1917.

GAGE.—Bristol water-stage recorder on left bank just below lake outlet. Prior to October 8, 1915, gage was 160 feet upstream, and referred to different datum.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Bed composed of coarse gravel well compacted; no well-defined control.

ICE.—Stage-discharge relation not seriously affected by ice.

EXTREMES OF DISCHARGE.—Maximum stage for year from gage-height graph, 3.93 feet at 7 p. m. June 29 (discharge, 116 second-feet); minimum stage, 0.72 foot at 6 p. m. September 12 (discharge, 0.2 second-foot).

DIVERSIONS.—No diversions above.

REGULATION.—Flow regulated naturally by Sand Lake which has an approximate area of 95 acres.

ACCURACY.—Stage-discharge relation practically permanent; not affected by ice. Rating curve well defined below 40 second-feet but not well defined above 40 second-feet. Operation of water-stage recorder satisfactory except for short periods as shown in the footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage height determined by inspecting gage-height graph. Records good below 40 second-feet; fair above.

COOPERATION.—Field data furnished by Rock Creek Conservation Co.

Discharge measurements of Deep Creek near Arlington, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 12	M. W. Gordon	1.18	2.60	July 14	M. W. Gordon	2.30	36.0
Dec. 3	.....do	.8	.27	27	S. B. Soulé	1.74	14.6
June 14	.....do	1.65	13.6	27	.....do	1.74	14.7

Daily discharge, in second-feet, of Deep Creek near Arlington, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	0.9	0.7	0.3	......	0.4	0.4	0.4	0.6	1.1	80	10	0.6
2	1.0	.7	.3	......	.4	.4	.5	.8	1.2	80	9.2	.6
3	.9	.8	.3	......	.4	.4	.4	1.2	1.4	80	11.0	.6
4	.9	.9	.4	......	.4	.4	.4	1.4	1.6	85	10.0	.6
5	1.0	.8	.3	......	.4	.3	.4	1.2	1.8	90	7.2	.6
6	1.0	.8	.3	......	.4	.3	.4	.8	2.4	90	5.4	.6
7	1.2	.7	.4	......	.4	.3	.4	.8	2.5	80	4.0	.6
8	1.4	.7	.3	......	.4	.3	.4	.8	2.8	58	3.7	.4
9	1.6	.8	.3	......	.4	.3	.4	.8	4.0	65	2.2	.3
10	1.8	.9	.3	......	.4	.3	.5	.7	4.4	60	1.5	.2
11	2.0	.8	.3	......	.4	.3	.4	.7	5.6	60	1.1	.2
12	2.3	.8	.3	......	.4	.4	.5	.7	7.8	60	.8	.2
13	2.1	.9	.3	......	.4	.3	.6	.7	9.8	62	.4	.2
14	1.9	1.0	.3	......	.4	.3	.6	.8	15	40	.4	.2
15	1.9	1.0	.3	......	.4	.3	.5	.7	17	45	.3	.3
16	1.9	.8	.3	......	.5	.3	.3	.9	18	31	.4	.3
17	1.7	.8	.3	......	.6	.3	.3	1.0	23	27	.4	.4
18	1.4	.8	.3	......	.6	.3	.7	1.0	38	24	.5	.3
19	1.4	.8	.3	......	.6	.4	1.4	1.1	80	24	.7	.3
20	1.4	.7	.3	......	.6	.3	1.5	1.1	80	22	.9	.3
21	1.3	.7	.3	......	.6	.3	1.0	1.2	90	23	.9	.3
22	1.2	.6	.3	......	.6	.2	.8	1.1	85	20	.7	.3
23	1.2	.6	.3	......	.5	.2	1.2	1.0	85	20	.4	.3
24	1.1	.6	.3	......	.6	.3	.8	1.1	90	13	.3	.4
25	1.0	.5	......	......	.6	.3	.5	1.0	90	12	.3	.4
26	1.1	.5	......	......	.6	.2	.6	1.0	90	11	.3	.3
27	1.0	.5	......	......	.6	.2	.9	1.3	90	12	.3	.3
28	.9	.4	......	......	.5	.2	1.0	1.4	90	11	.3	.3
29	.9	.4	......	0.4	......	.5	1.0	1.4	100	10	.3	.3
30	.7	.4	......	.4	......	.4	.7	1.2	95	10	.4	.3
31	.8	......	......	.4	......	.4	......	1.2	......	12	.5	......

NOTE.—Oct. 7-11, water-stage recorder out of order; discharge interpolated. Dec. 25 to Jan. 28 recorder not running; discharge estimated.

Monthly discharge of Deep Creek near Arlington, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	2.3	0.7	1.32	81.2
November	1.0	.4	.71	42.2
December	.4	.3	.30	18.4
January	......	......	.30	18.4
February	.6	.4	.48	26.7
March	.5	.2	.32	19.7
April	1.5	.3	.65	38.7
May	1.4	.6	.99	60.9
June	100	1.1	40.7	2,420
July	90	10	42.5	2,610
August	11	.3	2.41	148
September	.6	.2	.37	22.0
The year	100	.2	7.62	5,510

MUDDY CREEK NEAR SHIRLEY, WYO.

LOCATION.—In sec. 14, T. 26 N., R. 80 W., at highway bridge near Point of Rocks, 6 miles east of Shirley, in Carbon County. Nearest tributary enters 4 miles above.

DRAINAGE AREA.—67 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 6, 1915, to April 15, 1917, when station was discontinued.

GAGE.—Vertical staff on downstream side of left abutment of bridge.

DISCHARGE MEASUREMENTS.—Made from single-span bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of earth; channel very winding and current sluggish, owing to slight slope (0.0011 foot). Principal control practically at gage during low and medium stages, but during high water is at first bend downstream. Left bank subject to overflow at stage about 3.5 feet. Right bank is overflowed at stage 6.6 feet.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 3.2 second-feet from Muddy Creek above station, and 4.8 second-feet below.

REGULATION.—None.

ACCURACY.—Owing to ice gorging in spring during principal high water, records only fair.

COOPERATION.—Assistance furnished by F. H. Richard.

Discharge measurements of Muddy Creek near Shirley, Wyo., during the year ending Sept. 30, 1917.

[Made by H. K. Smith.]

Date.	Discharge.	Date.	Discharge.	Date.	Discharge.
	Sec.-ft.		*Sec.-ft.*		*Sec.-ft.*
Apr. 8	14.1	Apr. 11	54	Apr. 13	54
8	15.0	11	75	14	27.3
9	107	12	45.8	15	21.8
10	86				

Daily discharge, in second-feet, of Muddy Creek near Shirley, Wyo., for the year ending Sept. 30, 1917.

Apr. 8	15.0	Apr. 11	64.4	Apr. 14	27.3
9	122	12	45.8	15	21.8
10	109	13	53.7		

NOTE.—Mean discharge Apr. 8 to 15, 57.4 second-feet; run-off for period, 911 acre-feet.

SAGE CREEK ABOVE PATHFINDER, WYO.

LOCATION.—In sec. 3, T. 26 N., R. 84 W., at footbridge at Vivion's ranch, 25 miles above Pathfinder dam, Carbon County. No tributary between station and mouth 2 miles below.

DRAINAGE AREA.—182 square miles (measured on base map of Wyoming; scale, 1:500,000 map).

RECORDS AVAILABLE.—March 20, 1915, to September 30, 1917.

GAGE.—Vertical staff 5 feet above footbridge at left bank; read by Mrs. Lewis Stillway and J. S. Wolf.

DISCHARGE MEASUREMENTS.—Made from footbridge or by wading.

CHANNEL AND CONTROL.—Bed composed of boulders embedded in sand. Control a short distance below bridge at riffle, which is permanent. Banks will be overflowed at stage of 6.5 feet. Stage of zero flow, 0.9 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.9 feet at 6 a. m. April 24 (discharge, 336 second-feet); minimum stage, 1.12 feet at 6 a. m. July 19 (discharge 0.6 second-foot).

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 16 second-feet from Sage Creek, all above the station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice during winter. Rating curve well defined below 220 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Sage Creek above Pathfinder, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 10	P. V. Hodges	2.57	80	May 14	H. W. Fear	3.20	196
11	....do	2.81	119	July 25	S. B. Soulé	1.16	.72

Daily discharge, in second-feet, of Sage Creek above Pathfinder, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.1	8.4		14	39	100	3.8	0.8	1.0
2	1.2	7.5		15	36	92	3.3	.8	2.0
3	1.4	7.5		16	31	109	3.1	.8	2.2
4	1.6	8.4		18	36	156	3.1	.8	2.1
5	2.2	8.4		13	44	146	2.8	.8	2.0
6	2.7	7.5		12	42	100	2.6	.8	2.8
7	3.5	6.9		11	37	100	2.5	.8	2.8
8	4.4	6.3		53	32	109	2.3	.8	2.8
9	4.4	7.5		84	39	118	2.1	.8	2.8
10	4.4	7.5		109	53	146	1.8	.8	2.8
11	3.0	8.1		118	78	127	1.9	.8	2.8
12	3.0	8.1		156	118	109	1.8	.8	2.8
13	2.9	8.1		236	166	82	1.6	.8	2.8
14	2.9	8.1		176	196	80	1.5	.8	2.8
15	3.0	8.1		158	216	72	1.3	.8	2.8
16	3.0	8.4		84	236	70	1.2	.8	2.8
17	3.1	9		100	226	72	1.1	.8	2.8
18	3.3	9		109	196	67	.9	.8	2.8
19	4.4	9		100	176	61	.7	.9	2.8
20	6.6	9		100	196	61	.9	.9	3.0
21	7.2	9.4		92	176	50	.8	.9	3.0
22	6.6	9.8		136	136	45	.8	.9	3.0
23	6.9	10		216	92	37	.8	.9	3.0
24	7.2	10		246	118	31	.8	.9	3.0
25	7.8	10	24	118	127	24	.8	.9	3.0
26	8.4		24	118	118	21	.8	.9	1.8
27	9.0		25	84	100	18	.8	.9	1.8
28	9.0		92	42	100	13	.8	.9	1.8
29	9.0		52	42	109	14	.8	.9	1.8
30	9.0		46	42	146	8.4	.8	1.0	1.8
31	8.7		22		127		.8	1.0	

Monthly discharge of Sage Creek above Pathfinder, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	9.0	1.1	4.87	299
November 1-26	10	6.3	8.40	417
March 25-31	92	22	40.7	565
April	246	11	93.9	5,590
May	236	31	114	7,010
June	156	8.4	74.6	4,440
July	3.8	.7	1.58	97
August	1.0	.8	.85	52
September	3.0	1.0	2.52	150

DEWEESE CREEK NEAR ALCOVA, WYO.

Location.—In sec. 18, T. 27 N., R. 84 W., at Weaver's ranch, near entrance of creek into Pathfinder Reservoir, in Carbon County.

Drainage area.—41 square miles (measured on base map of Wyoming; scale, 1:500,000).

Records available.—March 4 to September 30, 1917.

Diversions.—Prior to December 31, 1916, there were adjudicated diversions of 4.4 second-feet from Deweese Creek above station.

Cooperation.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Deweese Creek near Alcova, Wyo., for the year ending Sept. 30, 1917.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	....	14.0	2.0	32	14	0.2	0.6
2	....	5.5	2.7	38	14	.2	.6
3	....	1.0	2.7	33	14	.2	.6
4	0.2	2.7	2.7	33	14	.3	.6
5	.2	5.3	2.7	33	14	.3	.6
6	.2	7.6	2.0	33	8.8	.4	.6
7	.2	10	1.5	33	4.3	.4	.6
8	.3	13	1.5	33	1.5	.4	.6
9	.3	13	1.5	33	.4	.4	.6
10	.4	13	1.5	33	.1	.5	.6
11	.4	13	1.5	33	.1	.5	.6
12	.3	13	1.5	33	.1	.5	.6
13	.3	13	1.5	33	.1	.5	.6
14	.3	13	1.5	33	.1	.6	.6
15	.3	13	2.0	20	.1	.6	.6
16	.2	13	2.0	18	.1	.6	.6
17	.2	14	3.4	18	.1	.6	.6
18	.2	14	6.6	18	.1	.6	.6
19	.2	2.7	8.8	18	.1	.6	.6
20	.2	2.7	13	18	.1	.6	.6
21	.3	2.7	15	18	.1	.6	.5
22	.4	2.7	19	18	.2	.6	.5
23	.6	2.7	21	18	.2	.6	.5
24	1.0	2.7	26	18	.2	.6	.5
25	2.7	2.7	26	18	.2	.6	.4
26	6.6	2.7	26	16	.2	.6	.4
27	10	2.7	27	16	.2	.6	.4
28	14	2	27	16	.2	.6	.4
29	14	2	27	14	.2	.6	.4
30	14	2	27	14	.2	.6	.4
31	14	....	30	....	.2	.6	....

Note.—Figures have been changed slightly to conform to computation rules of the United States Geological Survey.

Monthly discharge of Deweese Creek near Alcova, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
March 4-31	14	0.2	2.93	163
April	14	1.0	7.38	439
May	30	1.5	10.8	664
June	38	14	24.7	1,470
July	14	.1	2.85	175
August	.6	.2	.50	30.7
September	.6	.4	.55	32.7
The period				2,970

SAND CREEK NEAR ALCOVA, WYO.

Location.—About sec. 25, T. 28 N., R. 85 W., at Weaver's ranch, 20 miles southwest of Alcova, in Carbon County. No tributary between station and Pathfinder reservoir, flow line of which is half a mile below.

Drainage area.—70 square miles (measured on base map of Wyoming; scale, 1:500,000 map).

Records available.—April 1, 1915, to September 9, 1917.

Gage.—Vertical staff read by Clarence Burtch.

Diversions.—Prior to December 31, 1916, there were adjudicated diversions of 28 second-feet from Sand Creek, all above the station.

Regulation.—None.

Cooperation.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Sand Creek near Alcova, Wyo., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	....	11.0	30	0.9	0.1	0.3	16	11	0.5	16	0.0	0.1	0.5
2	....	11.0	30	.9	.1	.4	17	11	.5	22	.0	.1	.5
3	....	16.0	30	.2	.1	.4	18	11	.5	22	.0	.1	.5
4	....	22.0	27	.2	.1	.4	19	11	.5	16	.0	.1	.5
5	....	27.0	27	.2	.2	.4	20	11	.5	16	.0	.1	.5
6	....	27.0	27	.2	.2	.4	21	11	.5	16	.0	.1	.5
7	....	27.0	27	.1	.2	.4	22	11	.5	16	.0	.1	.5
8	22	2.5	27	.1	.2	.4	23	5.4	27	16	.0	.1	.5
9	22	.0	27	.0	.2	.5	24	5.4	27	16	.0	.1	.5
10	22	.5	27	.0	.2	.5	25	5.4	27	11	.0	.1	.5
11	22	.5	27	.0	.2	.5	26	5.4	27	2.5	.1	.2	.5
12	11	.5	27	.0	.2	.5	27	5.4	27	2.5	.1	.2	.5
13	11	.5	27	.0	.2	.5	28	5.4	27	2.5	.1	.2	.5
14	11	.5	27	.0	.1	.5	29	5.4	27	2.5	.1	.3	.5
15	11	.5	27	.0	.1	.5	30	11	27	2.5	.1	.3	.5
							31	....	27	....	.1	.3	....

Monthly discharge of Sand Creek near Alcova, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 8-30	22	5.4	11.2	511
May	27	.0	12.7	781
June	30	2.5	19.8	1,180
July	.9	.0	.11	6.8
August	.3	.1	.16	9.8
September	.5	.3	.47	28.0
The period				2,520

Note.—Figures have been changed slightly to conform to computation rules of United States Geological Survey.

SWEETWATER RIVER NEAR ALCOVA, WYO.

Location.—In sec. 17, T. 29 N., R. 86 W., at Schoonmaker's ranch, 27 miles west of Alcova, in Natrona County. Backwater from Pathfinder reservoir comes to a point 5 miles below. Nearest tributary, Dry Creek, enters 6 miles below.

Drainage area.—2,270 square miles (measured on base map of Wyoming; scale, 1:500,000).

Records available.—August 28, 1913, to September 30, 1917.

Gage.—Vertical staff on left bank at old bridge abutment 200 feet above footbridge; read by H. D. Schoonmaker.

DISCHARGE MEASUREMENTS.—Made from footbridge or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel. Control 25 feet downstream at small rapids which change during high water. Banks high and not subject to overflow.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 102 second-feet from Sweetwater River, above station. The original diversions below the station have been done away with by the Pathfinder reservoir.

REGULATION.—None.

COOPERATION.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second feet, of Sweetwater River near Alcova, Wyo., for the year ending Sept. 30, 1917.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		237	380	988	1,030	90	67
2		257	315	950	930	82	65
3		338	310	910	894	79	65
4		338	355	912	843	74	65
5		310	315	908	713	70	67
6		70	310	937	620	70	66
7		65	310	882	570	69	60
8		85	238	865	523	68	60
9		103	257	843	498	70	60
10		96	272	880	500	70	60
11		108	298	992	469	70	60
12		157	345	972	404	76	60
13		605	468	972	392	75	60
14		860	655	1,180	333	79	60
15		882	810	1,250	277	78	60
16		607	988	1,280	273	76	60
17		445	1,110	1,310	225	76	60
18		275	1,180	1,310	186	76	60
19		245	1,280	1,320	165	79	60
20		132	1,350	1,320	142	79	60
21		148	1,280	1,320	138	79	60
22		140	1,240	1,350	134	79	60
23		148	1,250	1,350	126	79	57
24		237	1,260	1,290	122	79	55
25		463	1,180	1,240	113	79	55
26		592	1,060	1,250	105	79	54
27		785	685	1,250	105	64	53
28		773	707	1,200	102	63	53
29		655	880	1,180	94	65	53
30	250	545	972	1,120	92	63	53
31	220		985		91	64	

NOTE.—Figures have been changed slightly to conform to computation rules of United States Geological Survey.

Monthly discharge of Sweetwater River near Alcova, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April	882	65	357	21,200
May	1,350	238	743	45,700
June	1,350	843	1,120	66,600
July	1,030	91	362	22,300
August	90	63	74.2	4,560
September	67	53	59.6	3,550
The period				164,000

[illegible] Introd[illegible]

[illegible] Summary [illegible]

[illegible] show pp. [illegible]

[illegible] Evening [illegible]

[illegible] discontinued [illegible]

[illegible] Service.

[illegible] for the year ending [illegible]

							Sept.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

onthly discharge of Horse Creek near Alcova, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
rch 21-31	119	10	36.9	805
ril	62	.7	12.7	815
y	7	.2	.72	44.3
ne	.4	.3	.31	18.4
ly	.60	.4	.49	30.1
gust	.70	.60	.64	39.4
ptember	.70	.70	.70	41.7
The period				1,790

OTE.—Figures have been changed slightly to conform to computation rules of United States Geological rvey.

CANYON CREEK NEAR ALCOVA, WYO.

CATION.—About in sec. 2, T. 28 N., R. 84 W., at Irvine's ranch, 12 miles southwest of Alcova, Carbon County. No tributary between station and Pathfinder reservoir, the flow line of which is 1 mile below gage.

AINAGE AREA.—54 square miles (measured on base map of Wyoming; scale, 1:500,000).

CORDS AVAILABLE.—April 1, 1915, to September 30, 1917.

GE.—Vertical staff; read by F. J. Irvine.

VERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 3.9 second-feet from Canyon Creek, and 13 second-feet from tributaries entering above.

GULATION.—None.

OPERATION.—Complete records furnished by United States Reclamation Service.

ily discharge, in second-feet, of Canyon Creek near Alcova, Wyo., for the year ending Sept. 30, 1917.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
	6.1	20	8.3	14	0.1	0.0	0.1
	6.1	18	8.0	11	.1	.0	.1
	4.5	8.9	9.9	24	.1	.1	.3
	4.8	8	7.1	24	.1	.1	.3
	5.8	9.9	9.9	20	.1	.1	.3
	4.5	10	7.1	17	.1	.1	.4
	4.5	9.9	6.1	13	.1	.1	.4
	3.9	22	7.6	11	.2	.1	.4
	3.5	68	8.3	9.9	.3	.1	.4
	3.2	50	7.1	8.3	.3	.1	.4
	4.5	35	9	7.1	.3	.1	.4
	3.2	77	15	29	.2	.1	.4
	3.7	68	20	5.8	.3	.2	.5
	3.9	40	27	4.5	.2	.2	.4
	3.2	42	35	2.1	.2	.2	.4
	3.9	32	40	1.4	.2	.2	.4
	3.7	24	31	.7	.2	.2	.5
	3.2	27	27	.7	.3	.3	.4
	4.5	22	23	.5	.3	.2	.4
	3.2	15	26	.6	.3	.1	.4
	3	23	24	.6	.3	.1	.4
	4.5	35	11	.6	.3	.1	.4
	3	51	8	5	3	.1	.4
	3.9	58	15	.5	.3	.1	.4
	3.9	25	22	4	.3	.1	.4
	3	26	21	.4	.1	.2	.4
	3.5	18	20	.4	.1	.3	.4
	18	14	20	.3	.1	.3	.4
	52	9.5	18	1	.1	.3	.4
	30	15.	22	.1	1	.3	.4
	22		16		.0	.3	

HORSE CREEK NEAR ALCOVA, WYO.

LOCATION.—About in sec. 22, T. 30 N., R. 85 W., at highway bridge near Bothw[illegible] ranch, 16 miles west of Alcova, in Natrona County. No tributary betw[illegible] station and Pathfinder reservoir, flow line of which is half a mile below gage.

DRAINAGE AREA.—119 square miles (measured on base map of Wyoming; sc[illegible] 1:500,000).

RECORDS AVAILABLE.—March 23, 1915, to September 30, 1917.

GAGE.—Vertical staff on right bank at lower side of bridge; read by Thomas Igoe.

DISCHARGE MEASUREMENTS.—Made from single-span bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of coarse gravel. Control a short dista[illegible] below gage.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued [illegible] winter.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of [illegible] second-feet from Horse Creek.

REGULATION.—None.

COOPERATION.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Horse Creek near Alcova, Wyo., for the year endi[illegible] Sept. 30, 1917.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept
1	....	31	7.0	0.3	0.4	0.60	0.
2	....	31	.7	.3	.4	.60	[illegible]
3	....	16	.7	.3	.4	.60	[illegible]
4	....	22	.7	.3	.4	.60	[illegible]
5	....	13	.7	.3	.4	.60	[illegible]
6	....	13	.7	.3	.4	.60	.7
7	....	16	.7	.3	.45	.60	.7
8	....	16	.7	.3	.45	.60	.7
9	....	62	.7	.3	.45	.60	.7
10	....	42	.7	.3	.45	.60	.7
11	....	31	.7	.3	.45	.60	.7
12	....	19	.7	.3	.50	.60	.7
13	....	25	.7	.3	.50	.60	.7
14	....	10	.7	.3	.50	.60	.7
15	....	16	.7	.3	.50	.65	.7
16	....	20	.5	.3	.50	.65	.7
17	....	13	.5	.3	.50	.65	.7
18	....	7	.5	.3	.50	.65	.7
19	....	1	.5	.3	.50	.65	.7
20	....	.8	.3	.3	.50	.65	.7
21	10	.7	.2	.3	.50	.65	.7
22	10	.7	.3	.3	.50	.65	.7
23	10	.7	.3	.3	.50	.65	.7
24	13	.7	.3	.3	.50	.65	.7
25	31	.7	.3	.3	.50	.65	.7
26	10	.7	.3	.3	.50	.65	.7
27	10	.7	.3	[illegible]	[illegible]	[illegible]	.7
28	[illegible]	.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
29	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
31	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Monthly discharge of Horse Creek near Alcova, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
March 21–31	119	10	36.9	805
April	62	.7	13.7	815
May	7	.2	.72	44.3
June	.4	.3	.31	18.4
July	.60	.4	.49	30.1
August	.70	.60	.64	39.4
September	.70	.70	.70	41.7
The period				1,790

NOTE.—Figures have been changed slightly to conform to computation rules of United States Geological Survey.

CANYON CREEK NEAR ALCOVA, WYO.

LOCATION.—About in sec. 2, T. 28 N., R. 84 W., at Irvine's ranch, 12 miles southwest of Alcova, Carbon County. No tributary between station and Pathfinder reservoir, the flow line of which is 1 mile below gage.

DRAINAGE AREA.—54 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 1, 1915, to September 30, 1917.

GAGE.—Vertical staff; read by F. J. Irvine.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 3.9 second-feet from Canyon Creek, and 13 second-feet from tributaries entering above.

REGULATION.—None.

COOPERATION.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Canyon Creek near Alcova, Wyo., for the year ending Sept. 30, 1917.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	6.1	20	8.3	14	0.1	0.0	0.1
2	6.1	18	8.0	11	.1	.0	.1
3	4.5	8.9	9.9	24	.1	.1	.3
4	4.8	8	7.1	24	.1	.1	.3
5	5.8	9.9	9.9	20	.1	.1	.3
6	4.5	10	7.1	17	.1	.1	.4
7	4.5	9.9	6.1	13	.1	.1	.4
8	3.9	22	7.6	11	.2	.1	.4
9	3.5	68	8.3	9.9	.3	.1	.4
10	3.2	50	7.1	8.3	.3	.1	.4
11	4.5	35	9	7.1	.3	.1	.4
12	3.2	77	15	29	.2	.1	.4
13	3.7	68	20	5.8	.3	.2	.5
14	3.9	40	27	4.5	.2	.2	[illegible]
15	3.2	42	35	2.1	.2	.2	[illegible]
[illegible]	3.9	32	40	1.4	.2	[illegible]	[illegible]
[illegible]	3.7	24	31	.7	.2	[illegible]	[illegible]
[illegible]	3.2	27	27	.7	.3	[illegible]	[illegible]
[illegible]	4.5	22	23	.5	.3	[illegible]	[illegible]
[illegible]	3.2	15	26	.6	.3	[illegible]	[illegible]
[illegible]	[illegible]	23	24	.6	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	35	11	.6	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	51	8	.5	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	58	15	.5	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	25	22	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	26	21	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	18	20	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	14	20	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	9.5	18	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Monthly discharge of Canyon Creek near Alcova, Wyo., for the year ending Sept. 30, 191

Month.	Discharge in second-feet.			Run-off i acre-feet.
	Maximum.	Minimum.	Mean.	
March	52	3	7.44	457
April	77	8	29.4	1,750
May	40	6.1	17.1	1,050
June	29	.1	6.95	414
July	.3	.0	.19	11
August	.3	.0	.15	9
September	.5	.1	.38	22
The period				3,710

NOTE.—Figures have been changed slightly to conform to computation rules of United States Geolo ical Survey

BATES CREEK NEAR CASPER, WYO.

LOCATION.—Approximately in sec. 12, T. 31 N., R. 82 W., near mouth of creek miles southwest of Casper, in Natrona County.

DRAINAGE AREA.—383 square miles (measured on base map of Wyoming; scal 1:500,000).

RECORDS AVAILABLE.—April 10, 1916, to August 31, 1917.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of second-feet from Bates Creek, all above the station.

COOPERATION.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Bates Creek near Casper, Wyo., for the year endi Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Day.	Apr.	May.	June.	July.	Aug.
1	8	31	114	0.3	0.3	16	114	181	17	0.3	0.
2	8	24	114	4.0	.3	17	181	152	44	.3	[illegible]
3	12	24	114	.2	.3	18	84	114	114	.3	[illegible]
4	8	31	114	.2	.3	19	114	114	12	.3	[illegible]
5	8	40	84	.2	.3	20	181	114	8	.3	[illegible]
6	40	84	64	.2	.3	21	329	181	4	.3	[illegible]
7	24	181	40	.2	.3	22	161	181	.3	.3	[illegible]
8	17	84	31	.3	.3	23	140	114	1	.3	[illegible]
9	12	114	31	.3	.3	24	181	84	1	.3	[illegible]
10	157	181	31	.5	.3	25	310	84	1	.3	[illegible]
11	84	114	31	4.0	.3	26	371	152	1	.3	[illegible]
12	114	114	114	.3	.0	27	181	133	.8	.3	[illegible]
13	157	114	24	.3	.0	28	140	114	.8	.3	[illegible]
14	158	114	24	.3	.0	29	64	152	.7	.3	[illegible]
15	134	114	24	.3	.0	30	40	152	.7	.3	[illegible]
						31		152		.3	[illegible]

Monthly discharge of Bates Creek near Casper, Wyo., for the year ending Sept. 30, 1917

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April	371	8	118	7,020
May	181	24	114	7,010
June	114	.3	38.7	2,300
July	4	.2	.53	32
August	.3	.0	.11	6.
The period				16,400

NOTE.—Figures have been changed slightly to conform to computation rules of United States Geologica Survey.

DEER CREEK AT GLENROCK, WYO.

LOCATION.—In sec. 4, T. 33 N., R. 75 W., near mouth of creek at Glenrock, in Converse County.

DRAINAGE AREA.—63 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 11, 1916, to September 30, 1917.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 48 second-feet from Deer Creek, all above the station.

COOPERATION.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Deer Creek at Glenrock, Wyo., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	650	291	603	73	3	4	16	510	1,350	125	7	2	5
2	380	166	560	66	3	4	17	382	1,150	125	5	2	5
3	435	166	570	59	3	4	18	328	1,050	125	5	2	5
4	418	166	525	52	3	4	19	290	982	119	5	2	5
5	247	166	522	44	3	4	20	266	945	117	5	2	5
6	332	166	496	34	2	4	21	226	857	117	4	2	5
7	343	180	485	31	2	4	22	835	733	113	4	3	5
8	205	180	466	28	2	4	23	1,110	604	103	4	3	5
9	205	266	455	25	2	4	24	1,090	626	95	4	3	5
10	247	215	422	22	2	4	25	1,090	693	95	4	3	5
11	247	457	266	19	2	5	26	1,070	814	85	4	3	5
12	247	626	253	16	2	5	27	1,010	877	94	4	3	5
13	422	814	247	13	2	5	28	967	712	85	4	3	5
14	555	900	191	11	2	5	29	626	647	80	3	3	5
15	430	1,350	160	19	2	5	30	877	647	80	3	3	5
							31	....	625	....	3	3	....

NOTE.—Figures have been changed slightly to conform to computation rules of United States Geological Survey.

Monthly discharge of Deer Creek at Glenrock, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April	1,110	205	535	31,800
May	1,350	166	625	38,400
June	603	80	259	15,400
July	73	3	18.7	1,150
August	3	2	2.5	152
September	5	4	4.7	278
The period	....	....	....	87,200

BOXELDER CREEK NEAR CAREYHURST, WYO.

LOCATION.—Approximately in sec. 7, T. 33 N., R. 73 W., near mouth of creek, 1½ miles east of Careyhurst, in Converse County.

DRAINAGE AREA.—193 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 17 to October 31, 1911; April 9, 1916, to September 30, 1917.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 80 second-feet from Boxelder Creek, all above the station.

COOPERATION.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Boxelder Creek near Careyhurst, Wyo., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	21	135	742	25	4	3	16	90	920	283	9	4	3
2	29	116	664	17	4	3	17	70	957	272	9	3	3
3	29	126	588	9	4	3	18	70	640	220	9	3	3
4	26	116	857	9	4	3	19	75	588	183	9	3	4
5	25	155	870	9	4	3	20	70	742	170	9	3	4
6	27	135	588	9	4	3	21	98	995	146	9	3	4
7	28	116	602	9	4	3	22	126	742	135	9	3	4
8	29	135	588	9	4	3	23	272	664	135	9	3	4
9	40	107	588	9	4	3	24	423	690	108	9	3	4
10	45	135	588	9	4	3	25	298	754	75	9	3	4
11	45	146	640	9	4	3	26	220	1,150	62	9	3	4
12	63	309	538	9	4	3	27	98	895	56	9	3	4
13	183	398	385	9	4	3	28	70	1,060	56	9	3	4
14	146	538	410	9	4	3	29	155	995	50	9	3	4
15	126	690	322	9	4	3	30	135	920	29	9	3	4
							31	....	844	....	4	3	....

Monthly discharge of Boxelder Creek near Careyhurst, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April	423	21	104	6,190
May	1,150	107	545	33,500
June	870	29	365	21,700
July	25	4	9.6	591
August	4	3	3.5	216
September	4	3	3.4	202
The period				62,400

NOTE.—Figures have been changed slightly to conform to computation rules of the United States Geological Survey.

WAGON HOUND CREEK NEAR LA BONTE, WYO.

LOCATION.—Approximately in sec. 16, T. 31 N., R. 71 W., near mouth of creek, at Eastman's ranch, 3 miles east of La Bonte, in Converse County.

DRAINAGE AREA.—145 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 11, 1916, to September 30, 1917.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 24 second-feet from Wagon Hound Creek, all above station.

COOPERATION.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Wagon Hound Creek near La Bonte, Wyo., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	....	108	221	3.0	0.2	0.2	16	....	136	25	1.0	0.2	0.2
2	....	121	194	3.0	.2	.2	17	48	207	23	1.0	.2	.2
3	....	136	179	3.0	.2	.2	18	48	108	23	1.0	.2	.2
4	....	108	165	3.0	.2	.2	19	92	179	17	1.0	.2	.2
5	....	121	150	3.0	.2	.2	20	92	342	13	1.0	.2	.2
6	....	108	136	3.0	.2	.2	21	92	248	13	1.0	.2	.2
7	....	121	121	3.0	.2	.2	22	108	289	9	1.0	.2	.2
8	....	108	108	1.0	.2	.2	23	136	248	9	1.0	.2	.2
9	....	92	92	1.0	.2	.2	24	165	221	9	1.0	.2	.2
10	....	136	92	1.0	.2	.2	25	108	330	9	1.0	.2	.2
11	....	150	82	1.0	.2	.2	26	150	342	6	1.0	.2	.2
12	....	150	69	1.0	.2	.2	27	121	275	6	1.0	.2	.2
13	....	303	59	1.0	.2	.2	28	136	289	6	1.0	.2	.2
14	....	179	48	1.0	.2	.2	29	108	261	3	1.0	.2	.2
15	....	194	35	1.0	.2	.2	30	121	248	3	1.0	.2	.2
							31	....	248	....	1.0	.2	....

Monthly dischargeof Wagon Hound Creek near La Bonte, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 17-30	165	48	109	3,020
May	342	92	197	12,100
June	221	3	64.2	3,820
July	3.0	1.0	1.45	89
August	.2	.2	.20	12.3
September	.2	.2	.20	11.9
The period				19,100

NOTE.—Figures have been changed slightly to comform to computation rules of the United States Geological Survey.

LA BONTE CREEK NEAR LA BONTE, WYO.

LOCATION.—Approximately in sec. 15, T. 31 N., R. 71 W., at Soden's ranch, near mouth of creek, 2 miles east of La Bonte, in Converse County.

DRAINAGE AREA.—270 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 12, 1916, to September 30, 1917.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 34 second-feet from La Bonte Creek, all above station.

COOPERATION.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of La Bonte Creek near La Bonte, Wyo., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1		242	1,110	29	0	0	16	136	978	275	3	0	1
2		270	1,120	29	0	0	17	131	945	265	2	0	0
3		332	925	23	0	0	18	187	806	202	2	0	0
4		390	1,020	15	0	0	19	250	873	173	2	0	0
5		360	953	13	0	0	20	225	1,300	156	2	1	0
6	37	308	821	12	0	0	21	292	1,260	136	2	1	0
7	37	335	715	10	0	0	22	375	1,090	131	2	1	0
8	37	335	695	8	0	0	23	465	828	111	2	1	0
9	67	332	657	5	0	1	24	635	473	94	2	1	0
10	124	292	640	4	0	1	25	497	998	77	2	1	0
11	107	345	591	3	0	1	26	475	1,730	63	1	1	0
12	120	498	490	3	0	1	27	355	1,530	57	1	1	0
13	240	437	441	3	0	1	28	292	1,750	53	4	1	0
14	225	718	368	3	0	1	29	263	1,580	41	0	0	0
15	166	855	324	3	0	1	30	247	1,530	36	0	0	0
							31		1,210		0	0	

NOTE.—Figures have been changed slightly to conform to computation rules of the United States Geological Survey.

Monthly discharge of La Bonte Creek near La Bonte, Wyo., fort he year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 6-30	635	37	239	11,900
May	1,750	242	805	49,500
June	1,120	36	425	25,300
July	29	0	6.1	375
August	1	0	.3	18.4
September	1	0	.3	17.9
The period				87,100

HORSESHOE CREEK NEAR GLENDO, WYO.

Location.—Approximately in sec. 26, T. 29 N., R. 68 W., at Hauf's ranch, near mouth of creek, 4 miles southeast of Glendo, in Platte County.

Drainage area.—203 square miles (measured on base map of Wyoming; scale, 1:500,000).

Records available.—April 16, 1916, to September 2, 1917.

Diversions.—Prior to December 31, 1916, there were adjudicated diversions of 81 second-feet from Horseshoe Creek, all above station.

Cooperation.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Horseshoe Creek near Glendo, Wyo., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	28	157	943	45	9	2	16	123	425	334	21	4	2
2	24	123	842	36	9	2	17	194	438	293	21	4	2
3	24	175	842	36	9	2	18	194	395	273	18	4	2
4	24	212	812	36	9	2	19	194	374	253	18	3	2
5	24	253	748	36	6	2	20	212	487	212	16	3	2
6	24	212	642	36	6	2	21	212	623	175	16	3	2
7	28	212	540	28	6	2	22	212	580	139	16	3	2
8	35	212	457	28	6	2	23	232	540	73	16	3	2
9	45	212	374	28	6	2	24	232	540	73	16	3	2
10	45	232	374	28	5	2	25	212	642	73	14	3	2
11	45	253	374	28	5	2	26	212	748	232	14	2	2
12	53	273	354	27	5	2	27	194	842	54	14	2	2
13	53	293	354	27	5	2	28	184	943	54	12	2	2
14	65	318	354	27	4	2	29	175	943	45	12	2	2
15	65	364	334	21	4	2	30	175	1,040	45	12	2	2
							31	....	1,040	....	12	2	....

Monthly discharge of Horseshoe Creek near Glendo, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April	232	24	118	7,020
May	1,040	123	455	28,000
June	943	45	356	21,200
July	45	12	23.1	1,420
August	9	2	4.5	277
September	2	2	2.0	119
The period				58,000

Note.—Figures have been changed slightly to conform to computation rules of the United States Geological Survey.

COTTONWOOD CREEK NEAR WENDOVER, WYO.

Location.—Approximately in sec. 16, T. 27 N., R. 67 W., near mouth of creek, 1½ miles south of Wendover, in Platte County.

Drainage area.—150 square miles (measured on base map of Wyoming; scale, 1:500,000).

Records available.—April 19, 1916, to September 30, 1917.

Diversions.—Prior to December 31, 1916, there were adjudicated diversions of 32 second-feet from Cottonwood Creek, all above station.

Cooperation.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Cottonwood Creek near Wendover, Wyo., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	....	24	340	18	2.0	2.2	16	4.6	139	38	4.4	2.4	2.4
2	....	27	321	18	2.0	2.2	17	4.6	122	36	3.4	2.4	2.4
3	....	28	250	7.4	1.8	2.4	18	5.0	122	36	3.4	1.8	2.4
4	....	38	246	7.4	1.8	2.4	19	5.0	73	36	3.4	1.8	2.4
5	4.4	64	209	6.0	2.2	2.4	20	6.4	137	36	3.4	1.8	2.4
6	4.4	64	209	6.0	2.4	2.4	21	6.0	137	21	3.4	1.8	2.4
7	4.4	62	182	5.0	2.4	2.4	22	6.0	137	21	3.4	1.8	2.4
8	4.4	62	172	4.4	2.4	2.4	23	8.4	135	17	3.4	1.8	2.4
9	4.4	52	162	4.4	2.4	2.4	24	15.5	135	12	3.4	1.8	3.0
10	4.4	52	148	4.4	2.4	2.4	25	22.4	302	11	3.4	1.8	3.0
11	4.4	52	148	4.4	2.4	2.4	26	22.4	445	11	3.4	1.8	3.0
12	4.4	69	120	4.4	2.4	2.4	27	22.4	419	255	3.4	1.8	3.0
13	4.4	96	110	4.4	2.4	2.4	28	21.5	368	38	3.4	1.8	3.0
14	4.6	116	87	4.4	2.4	2.4	29	21.5	364	28	2.0	2.2	3.0
15	4.6	139	52	4.4	2.4	2.4	30	22.8	368	29	2.0	2.2	3.0
							31	....	354	....	2.0	2.2	....

Monthly discharge of Cottonwood Creek near Wendover, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 5-30	22.8	4.4	9.36	482
May	445	24	152	9,350
June	340	11	112	6,660
July	18	2.0	4.97	306
August	2.4	1.8	2.10	129
September	3.0	2.2	2.53	151
The period	....	....	....	17,100

NOTE.—Figures have been changed slightly to conform with computation rules of the United States Geological Survey.

LARAMIE RIVER NEAR JELM, WYO.

LOCATION.—In sec. 15, T. 12 N., R. 77 W., at highway bridge at Boswell's ranch a quarter of a mile below Colorado-Wyoming line, 4 miles south of Jelm, in Albany County.

DRAINAGE AREA.—293 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 7, 1911, to September 30, 1917. From June 22, 1904, to October 31, 1905, a station was maintained at Decker's ranch, half a mile south of the State line. The records at the two stations are comparable, as no large tributaries or diversions intervene.

GAGE.—Bristol water-stage recorder on downstream side of right bridge abutment.

DISCHARGE MEASUREMENTS.—Made from two-span bridge or by wading.

CHANNEL AND CONTROL.—Channel composed of gravel; control a short distance downstream, slightly shifting. Left bank is overflowed at gage height 3.0 feet. Flow passes through three well-defined, high-stage channels.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.92 feet at 8.30 a. m. June 23 (discharge, 3,390 second-feet); minimum discharge occurs during winter.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

DIVERSIONS.—Court decrees for diversions of 349 second-feet from Laramie River above station and 800 second-feet from tributaries. Of this amount 688 second-feet are for diversion into the Cache La Poudre drainage basin. During 191 11,502 acre-feet were diverted between July 3 and December 1. Also a condition decree not exceeding 1,235 second-feet into the Cache La Poudre basin throug the Laramie-Poudre tunnel. During 1917 tunnel diverted 392 acre-feet betwee August 4 and 25.

REGULATION.—None.

COOPERATION.—Station maintained in cooperation with the State engineer of Col rado, and records published as furnished by that office. Check measuremen made by engineers of the United States Geological Survey.

ACCURACY.—Stage-discharge relation changed slightly during period when gage w not read. Rating curve used October 1–14 well defined between 40 and 2 second-feet; curve used April 24 to September 30 well defined between 40 an 3,000 second-feet. The operation of the water-stage recorder was satisfactor Daily discharge ascertained by applying to rating table mean daily gage heig determined by inspecting the gage-height graph. Records only fair because c the small scale of the Bristol gage-height graph.

Discharge measurements of Laramie River near Jelm, Wyo., during the year ending Sep 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft*
May 18	H. W. Fear	2.90	994	Aug. 14	J. H. Baily	1.40	14
June 18	Robert Follansbee	3.75	2,870	29	do	1.28	13
July 1	W. A. Whitney	3.64	2,330				

Daily discharge, in second-feet, of Laramie River near Jelm, Wyo., for the year endin Sept. 30, 1917.

Day.	Oct.	Apr.	May.	June.	July.	Aug.	Sept.
1	80	....	154	512	2,300	305	[illegible]
2	100	....	141	512	2,020	288	[illegible]
3	110	....	154	576	1,780	269	[illegible]
4	110	....	128	728	1,480	269	[illegible]
5	80	....	116	648	1,480	232	[illegible]
6	110	....	116	818	1,480	218	[illegible]
7	110	....	116	818	1,390	202	[illegible]
8	110	....	104	970	1,310	202	[illegible]
9	100	....	128	2,160	1,090	186	[illegible]
10	100	....	141	2,460	1,090	222	[illegible]
11	80	....	168	2,620	1,680	205	[illegible]
12	80	....	183	2,160	1,090	146	[illegible]
13	90	....	199	1,900	818	146	[illegible]
14	80	....	309	1,900	728	146	[illegible]
15	....	....	512	2,300	685	146	[illegible]
16	....	....	770	2,460	583	136	[illegible]
17	....	....	970	2,800	518	111	[illegible]
18	....	....	1,030	2,800	432	100	[illegible]
19	....	....	1,030	2,460	487	111	[illegible]
20	....	....	1,030	2,460	493	136	[illegible]
21	....	....	1,090	2,620	437	149	[illegible]
22	....	....	918	2,800	386	149	[illegible]
23	....	....	770	2,970	339	149	[illegible]
24	....	215	648	2,800	470	149	[illegible]
25	....	199	576	2,970	416	149	[illegible]
26	....	183	512	2,970	470	151	[illegible]
27	....	154	454	2,620	391	166	[illegible]
28	....	168	512	2,300	367	166	[illegible]
29	....	141	512	2,160	284	114	[illegible]
30	....	154	481	2,300	305	114	[illegible]
31	....	....	610	....	371	91	....

NOTE.—July 16-Sept. 30, discharge computed by shifting-control method.

Monthly discharge of Laramie River near Jelm, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October 1-14	110	80	95.7	2,660
April 24-30	215	141	173	2,400
May	1,090	104	470	28,900
June	2,970	512	2,000	119,000
July	2,300	284	876	53,900
August	305	91	172	10,600
September	93	62	81.0	4,820

LARAMIE RIVER AND PIONEER CANAL NEAR WOODS, WYO.

LOCATION.—In sec. 36, T. 14 N., R. 77 W., at diversion dam for Pioneer canal, 2 miles above Woods post office, Albany County. Nearest important tributary, Fox Creek, enters 3 miles above.

DRAINAGE AREA.—409 square miles (measured on base map of Wyoming; scale, 1:500,000.)

RECORDS AVAILABLE.—April 16, 1912, to September 12, 1917. From 1895 to 1900, and from May 7 to November 11, 1911, a station was maintained at Woods Landing in sec. 11, T. 13 N., R. 77 W. The records are not directly comparable, as Fox Creek enters between and a few small ditches divert water.

GAGE.—Bristol water-stage recorder with its datum at the crest of dam, was moved September 23, 1915, to upper wing wall of head gates, and although actually above canal intake, it still indicates flow over dam as it is the pool formed by diversion dam. Gage originally at left end of dam just below Pioneer canal head gates. Chain gage in Pioneer canal is at Johnson Bridge, 1½ miles below intake; read by Wesley Johnson.

DISCHARGE MEASUREMENTS.—Made from cable 2,000 feet above dam. Measurement of Pioneer canal made at Johnson Bridge and this quantity is subtracted from flow at cable to determine flow at diversion dam.

CHANNEL AND CONTROL.—Channel at gage is pool formed by concrete diversion dam about 2 feet high. Control is dam itself and is permanent. Banks high and will not overflow. Stage of zero flow is 0.00 foot. Bed of canal composed of shale which changes somewhat; control at concrete drop 1 mile downstream.

EXTREMES OF DISCHARGE.—Laramie River: Maximum stage during year from water-stage recorder, 4.4 feet from 8 a. m. to noon June 23 (discharge, 3,310 second-feet); minimum stage recorded (mean for day), 0.08 foot November 6 (discharge, 12 second-feet).

Pioneer canal: Maximum stage recorded, 5.8 feet at 9.20 a. m. June 19 (discharge, 818 second-feet); minimum discharge of about 2 second-feet occurs during winter when gates are closed.

ICE.—Stage-discharge relation seldom affected by ice as crest of dam is kept free from ice.

DIVERSIONS.—By decree of district court dated December 27, 1912, there were adjudicated diversions of about 10 second-feet from Laramie River between the State line and Pioneer dam, exclusive of the Pioneer canal, which has decrees for 282 second-feet.

REGULATION.—None, as pond above dam is too small to have any appreciable effect on flow. Whenever canal head gates are closed the discharge over dam increases.

ACCURACY.—Laramie River station: Stage-discharge relation practically permanent; slightly affected by ice. Rating curve is well defined between 20 and 1,800 second-feet. Operation of the water-stage recorder was satisfactory throughout the year. Daily discharge ascertained by applying to rating table mean daily gage height determined by inspecting gage-height graph.

Pioneer canal station: Stage-discharge relation slightly shifting. Rating curve used October 1 to November 9 well defined between 20 and 100 second-feet, and curve used April 25 to September 30 well defined between 10 and 1,000 second-feet. Gage read to quarter-tenths once or twice daily. Daily discharge ascertained by applying the one daily gage height or the mean of two daily gage heights to the rating table. Records are good except for periods of missing gage height, when they are fair.

Discharge measurements of Laramie River near Woods, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 18	H. K. Smith	0.26	40.5	July 28	S. B. Soulé	1.02	345
Jan. 8	.....do	.32	61	Sept. 13	.....do	.40	76
May 19	H. W. Fear	2.46	1,530				

Daily discharge, in second-feet, of Laramie River near Woods, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	42	15	81	58	60	42	65	131	720	1,700	222	76
2	46	15	81	60	58	46	60	128	720	1,470	208	68
3	55	15	84	63	58	51	55	111	624	1,250	185	63
4	55	15	81	68	55	53	55	114	448	1,000	165	55
5	55	15	81	71	55	51	58	131	522	928	153	63
6	65	12	73	65	51	44	55	105	484	1,100	128	63
7	68	12	68	60	51	37	60	102	378	1,160	121	71
8	63	12	68	63	55	44	71	93	600	1,140	111	68
9	60	12	73	58	63	48	78	102	1,120	1,060	96	51
10	55	87	65	58	60	46	84	99	2,010	1,040	118	51
11	53	87	60	63	55	44	105	111	2,320	1,340	105	55
12	53	87	63	63	55	42	131	142	2,100	1,130	96	55
13	55	87	60	60	53	37	177	185	2,010	880	96	68
14	55	87	68	55	53	40	177	333	1,960	760	93	68
15	44	87	76	53	55	42	145	499	2,010	680	96	76
16	33	87	68	44	58	44	128	816	2,240	568	102	68
17	44	96	68	44	55	44	145	1,120	2,420	484	102	60
18	48	96	73	46	55	44	145	1,340	2,370	448	90	55
19	42	90	65	51	53	40	138	1,420	2,320	499	90	55
20	35	84	60	53	48	35	111	920	2,280	522	165	44
21	35	81	63	53	44	35	114	680	2,320	448	165	44
22	35	81	68	54	51	37	128	507	2,640	412	165	44
23	33	81	71	56	53	42	157	448	2,910	378	153	37
24	29	87	68	57	53	42	190	484	2,550	412	153	35
25	28	90	68	58	51	41	185	522	2,460	412	145	33
26	29	87	68	58	40	40	208	448	2,280	345	145	33
27	28	81	63	60	35	33	194	412	2,140	284	128	46
28	26	81	63	58	40	33	149	560	1,920	284	128	60
29	20	81	65	58	....	43	138	640	1,780	258	96	68
30	20	81	63	55	....	53	134	680	1,830	258	96	55
31	15	....	60	55	....	68	....	816	....	231	81	....

NOTE.—Jan. 22–24, Mar. 25, 29, stage-discharge relation affected by ice; discharge interpolated. Nov. 7–14, Apr. 30–May 1, 28–29, July 27–31, no gage-height record as water-stage recorder was out of order; discharge estimated.

Monthly discharge of Laramie River near Woods, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	68	15	42.7	2,630
November	96	12	64.3	3,830
December	84	60	68.9	4,240
January	71	44	57.4	3,530
February	63	35	52.6	2,920
March	68	33	43.3	2,660
April	208	55	121	7,200
May	1,420	93	458	28,200
June	2,910	378	1,750	104,000
July	170	231	738	45,400
August	222	81	129	7,930
September	76	33	56.3	3,350
The year	2,910	12	298	216,000

NOTE.—The above tables do not include the discharge of Pioneer canal, which diverts water from the pool in which the gage is located.

Discharge measurements of Pioneer canal near Woods, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 19	H. W. Fear	2.14	136	July 28	S. B. Soulé	1.96	106
June 18	Robert Follansbee	5.79	802	Sept. 13	do	.79	12.6

Daily discharge, in second-feet, of Pioneer canal near Woods, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	47	70		40	119	657	101	15
2	47	70		46	119	606	92	14
3	48	70		52	508	126	87	13
4	48	70		58	581	126	87	13
5	48	70		64	606	126	87	13
6	49	70		69	606	126	87	13
7	49	70		72	631	126	82	20
8	49	70		76	683	126	78	16
9	52	70		80	736	126	78	13
10	55			84	581	126	78	13
11	58			87	556	126	78	13
12	61			92	606	126	71	13
13	64			97	631	126	64	13
14	66			102	631	126	60	13
15	68			107	709	126	60	13
16	70			112	736	126	60	13
17	70			117	485	126	60	13
18	70			122	790	126	60	13
19	70			126	818	126	78	13
20	70			252	657	126	19	13
21	70			295	736	121	16	13
22	70			295	790	121	16	13
23	70			310	508	116	16	13
24	70			380	581	121	16	13
25	70		5	136	606	121	16	13
26	70		10	380	683	116	14	13
27	70		16	295	709	111	16	13
28	70		22	280	709	111	16	13
29	70		28	420	709	106	16	13
30	70		34	119	736	106	16	13
31	70			119		111	16	

NOTE.—Nov. 10–Apr. 24 gates closed; discharge estimated at 2 second-feet. Oct. 1–7, 9–15, 17–23, 25–31, Nov. 2–9, Apr. 26–May 5, 7–10, 12–18, July 3–18, Sept. 1–3, 9–12, 14–30 discharge estimated, as gage was not read.

Monthly discharge of Pioneer canal near Woods, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	70	47	62.2	3,820
November	70	3	22.4	1,330
December			2	123
January			2	123
February			2	111
March			2	123
April	34	2	5.4	321
May	420	40	158	9,720
June	818	119	619	36,800
July	657	106	155	9,530
August	101	14	52.9	3,250
September	20	13	13.4	797
The year	818		91.2	66,000

Combined monthly discharge of Laramie River and Pioneer canal near Woods, Wyo., for, the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	121	85	105	6,460
November	98	82	86.7	5,160
December	86	62	70.9	4,360
January	73	46	59.4	3,650
February	65	37	54.6	3,030
March	70	35	45.3	2,790
April	218	57	126	7,500
May	1,550	163	616	37,900
June	3,420	839	2,370	141,000
July	2,360	342	893	54,900
August	323	97	182	11,200
September	91	46	69.7	4,150
The year	3,420	35	389	282,000

LARAMIE RIVER AT TWO RIVERS, WYO.

Location.—In sec. 5, T. 17 N., R. 74 W., at highway bridge at Two Rivers, Albany County. Nearest tributary, Little Laramie River, enters a quarter of a mile below.

Drainage area.—1,290 square miles (measured on base map of Wyoming; scale 1:500,000).

Records available.—May 6, 1911, to October 31, 1912; October 1, 1913, to August 15, 1917. Station maintained by State engineer during 1913 and 1914.

Gage.—Bristol water-stage recorder on left bank just above bridge. Gage used since 1915 was referred to datum 0.74 foot higher than that of 1912. Gage on left bank 400 feet above bridge used during 1913 and 1914.

Discharge measurements.—Made from bridge or by wading.

Channel and control.—Bed composed of sand and gravel, and is shifting; no well-defined control. Banks are high and not subject to overflow.

Extremes of discharge.—Maximum from water-stage recorder, 6.35 feet on June 22, 25, and 26 (discharge, 2,560 second-feet); minimum probably occurs during winter.

Ice.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

Diversions.—By decree of district court dated December 27, 1912, there were adjudicated diversions of 414 second-feet from Laramie River between this and the station near Woods.

REGULATION.—None.

ACCURACY.—Stage-discharge relation slightly shifting; affected by ice during winter. Rating curve well defined between 20 and 2,600 second-feet. The operation of the water-stage recorder was satisfactory except for a few days, as explained in footnote. Daily discharge ascertained by applying to the rating table the mean daily gage heights determined by inspecting gage-height graph, except for periods April 16 to June 15 and June 23 to August 15, when discharge was computed by indirect method for shifting control. Records good.

Discharge measurements of Laramie River at Two Rivers, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 20	H. K. Smith	1.87	210	July 29	S. B. Soulé	2.50	332
June 21	Robert Follansbee	6.25	2,480	Sept. 15	....do	1.12	62

Daily discharge, in second-feet, of Laramie River at Two Rivers, Wyo., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1		193	1,140	1,940	289		16	228	232	2,330	800		62
2		203	1,320	1,870	276		17	206	352	2,300	686		62
3		226	1,290	1,830	263		18	228	566	2,330	600		61
4		223	1,160	1,720	228		19	239	726	2,440	526		60
5		212	961	1,450	217		20	239	868	2,520	509		56
6		201	884	1,160	195		21	228	1,050	2,520	526		54
7		191	884	1,040	174		22	195	1,080	2,560	492		50
8		178	884	1,130	164		23	195	1,000	2,480	424		48
9		164	853	1,160	158		24	195	843	2,480	361		
10		151	956	1,100	153		25	228	748	2,550	331		
11		149	1,220	1,190	147		26	251	889	2,550	361		
12		140	1,540	1,280	147		27	249	1,170	2,510	361		
13		140	1,960	1,370	144		28	226	1,110	2,430	376		
14		149	2,420	1,210	135		29	237	940	2,240	346		
15		178	2,380	924	129	62	30	214	814	2,130	331		
							31		940		302		

NOTE.—May 8–9, July 11–12, no gage-height record, as water-stage recorder was out of order; discharge interpolated.

Monthly discharge of Laramie River at Two Rivers, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 16–30	251	195	224	6,660
May	1,170	140	517	31,800
June	2,560	853	1,870	111,000
July	1,940	302	894	55,000
August 1–15	289	129	188	5,590

LARAMIE RIVER NEAR LOOKOUT, WYO.

LOCATION.—About sec. 33, T. 21 N., R. 74 W., at steel highway bridge 9 miles northeast of Lookout, Albany County. No important tributary between station and Wheatland reservoir No. 2, a short distance downstream.

DRAINAGE AREA.—2,100 square miles (measured on base map of Wyoming; scale, 1:500,000).

Records available.—April 22, 1915, to August 30, 1917. State engineer maintained station at this point during 1913 and 1914.

Gage.—Bristol water-stage recorder on upstream side of right bridge abutment.

Discharge measurements.—Made from single-span bridge or by wading.

Channel and control.—Bed composed of sand and silt. Control a short distance downstream; shifts slightly at intervals; practically permanent during 1917.

Extremes of discharge.—Maximum stage during year occurred June 26, at a time when recording gage was not in operation; discharge as estimated from flow at other Laramie River stations, 3,100 second-feet. Minimum discharge probably occurs during winter.

Ice.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

Diversions.—By decree of district court dated December 27, 1912, there were adjudicated diversions of 211 second-feet from Laramie River between Two Rivers and Lookout station.

Regulation.—None.

Accuracy.—Stage-discharge relation practically permanent; affected by ice during winter. Rating curve used October 1 to 22 well defined between 20 and 100 second-feet; curve used April 17 to September 30 well defined between 20 and 2,800 second-feet. Operation of the water-stage recorder fairly satisfactory except for intervals as explained in footnote. Daily discharge ascertained by applying to the rating tables mean daily gage heights determined by inspecting gage-height graph. Records good, except during periods when there was no gage-height record, when they are fair.

Discharge measurements of Laramie River near Lookout, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
June 19	Robert Follansbee	5.56	2,580
July 30	S. B. Soulé	2.70	467
Sept. 14	.....do	1.59	72

Daily discharge, in second-feet, of Laramie River near Lookout, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Apr.	May.	June.	July.	Aug.	Day.	Oct.	Apr.	May.	June.	July.	Aug.
1	34	....	384	1,230	2,150	430	16	27	....	244	2,380	1,160	140
2	34	....	361	1,160	2,200	384	17	27	1,460	280	2,290	1,010	140
3	34	....	430	1,080	2,120	361	18	27	1,160	406	2,290	806	140
4	34	....	505	1,010	2,040	300	19	34	1,620	589	2,470	679	140
5	34	....	454	940	1,780	280	20	42	1,300	806	2,580	618	178
6	34	....	406	872	1,540	262	21	34	872	940	2,520	618	194
7	34	....	361	806	1,300	224	22	20	702	1,230	2,450	648	53
8	34	....	340	872	1,380	210	23	....	532	1,300	2,400	589	73
9	34	....	300	872	1,540	194	24	....	361	1,080	2,600	532	91
10	34	....	280	940	1,540	172	25	....	361	940	3,000	480	77
11	34	....	262	1,080	1,540	166	26	....	384	940	3,100	454	84
12	34	....	244	1,460	1,540	166	27	....	742	1,080	2,800	532	108
13	34	....	244	1,700	1,950	154	28	....	1,860	1,380	2,600	532	77
14	34	....	244	2,120	1,950	157	29	....	1,620	1,380	2,500	480	57
15	20	....	244	2,470	1,460	145	30	....	940	1,380	2,350	430	50
							31	....	....	1,300	....	454	50

Note.—Oct. 2–10, Apr. 22–23, June 20–July 2, no gage-height record, because water-stage recorder was out of order. Discharge interpolated Oct. 2–10, Apr. 22–23, and based on comparative hydrograph of Laramie River near Woods June 20–July 2.

Monthly discharge of Laramie River near Lookout, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October 1-22	42	20	32.1	1,400
April 17-30	1,860	361	994	27,600
May	1,380	244	656	40,300
June	3,100	806	1,900	113,000
July	2,200	430	1,120	68,900
August	430	50	170	10,500

LARAMIE RIVER BELOW McGILL, WYO.

LOCATION.—In sec. 33, T. 23 N., R. 73 W., at J. T. Dodge's ranch, 8 miles below McGill, Albany County. No tributary between station and outlet of Wheatland reservoir No. 2.

DRAINAGE AREA.—2,230 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 4, 1916, to September 13, 1917.

GAGE.—Bristol recording gage referred to vertical staff on left abutment of private bridge; read by Mrs. Mary E. Dodge.

DISCHARGE MEASUREMENTS.—Made from single-span bridge or by wading.

CHANNEL AND CONTROL.—Channel composed of coarse gravel; control at small rapids 100 feet downstream, which are apparently permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.6 feet June 26–30 (discharge, 2,860 second-feet); minimum stage occurs during winter, when flow is practically zero due to storage in Wheatland reservoir.

ICE.—No data.

DIVERSIONS.—One small diversion between station and that near Lookout (see "Regulation").

REGULATION.—Flow shows effect of storage in Wheatland reservoir, which has an adjudicated decree for 633 second-feet and a storage capacity of about 110,000 acre-feet. Flow entirely regulated by reservoir, as river passes through it.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined up to 2,600 second-feet. Operation of water-stage recorder fairly satisfactory. Daily discharge ascertained by applying to rating table the mean daily gage height determined by inspecting gage-height graph. Records good.

Discharge measurements of Laramie River below McGill, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
June 19	Robert Follansbee	4.70	2,140
July 30	S. B. Soule	2.68	739
Sept. 14	....do	1.58	176

Daily discharge, in second-feet, of Laramie River below McGill, Wyo., for the year ending Sept. 30, 1917.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1			2,700	670	408	16		1,860	1,780	610	
2			2,540	670	380	17	47	2,000	1,700	610	
3			2,160	670	380	18	48	2,080	1,630	610	
4			2,160	670	380	19	50	2,230	1,490	580	
5			1,860	670	380	20	50	2,300	1,420	520	
6			1,630	640	323	21	48	2,380	1,350	520	
7			1,420	640	265	22	45	2,540	1,350	490	
8			1,350	640	285	23	38	2,700	1,350	490	
9			1,420	640	228	24	36	2,780	1,280	490	
10		930	1,630	640	195	25	42	2,780	1,350	520	
11		898	1,700	640	195	26	50	2,860	1,350	490	
12		865	1,780	640	166	27	50	2,860	1,280	462	
13		1,280	1,780	640	141	28		2,860	1,290	435	
14		1,490	1,780	640		29		2,860	1,280	380	
15		1,630	1,860	640		30		2,860	768	380	
						31			720	380	

Monthly discharge of Laramie River below McGill, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
May 17-27	50	36	45.8	999
June 10-30	2,860	865	2,140	89,100
July	2,700	720	1,590	97,800
August	670	380	572	35,200
September 1-13	408	141	287	7,400

LARAMIE RIVER AT FORT LARAMIE, WYO.

Location.—At highway bridge in sec. 28, T. 26 N., R. 64 W., at Fort Laramie, in Goshen County. No important tributary between station and mouth, 1½ miles below.

Drainage area.—4,580 square miles (measured on base map of Wyoming; scale, 1:500,000).

Records available.—April 4, 1915, to September 30, 1917.

Gage.—Vertical staff.

Discharge measurements.—Made from highway bridge.

Channel and control.—No data.

Extremes of discharge.—Data not available.

Ice.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

Diversions.—By decree of district court dated December 27, 1912, there are adjudicated diversions of 61 second-feet between station below McGill and Fort Laramie.

Regulation.—(See Laramie River below McGill.)

Cooperation.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Laramie River at Fort Laramie, Wyo., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	35	292	3,560	3,260	240	110	16	230	1,340	2,390	1,640	220	106
2	43	318	3,560	3,200	220	110	17	220	1,420	2,390	1,500	175	69
3	75	292	3,700	2,980	220	108	18	175	1,480	2,540	1,340	130	64
4	60	340	3,560	2,840	175	105	19	216	1,280	2,540	1,120	130	60
5	43	380	4,000	2,690	175	96	20	200	1,500	2,390	900	150	60
6	35	398	4,280	1,710	780	92	21	175	1,840	2,390	692	160	83
7	28	420	4,140	1,500	292	89	22	160	2,120	2,390	600	132	92
8	24	410	4,000	1,280	268	89	23	212	2,060	2,390	518	108	92
9	20	448	3,840	1,500	268	92	24	370	1,640	2,540	445	100	92
10	20	465	3,560	800	240	92	25	620	1,870	2,690	692	89	96
11	20	388	3,200	924	220	92	26	448	2,140	2,840	1,050	79	78
12	268	465	2,090	924	220	92	27	420	2,760	3,200	780	79	69
13	248	692	1,640	986	175	92	28	350	2,980	3,700	518	89	83
14	340	900	1,790	986	150	118	29	270	3,050	3,260	345	108	83
15	400	1,050	2,100	1,640	195	118	30	292	3,200	3,260	320	160	96
							31	....	3,490	....	270	130	....

NOTE.—Figures have been changed slightly to conform to computation rules of United States Geological Survey.

Monthly discharge of Laramie River at Fort Laramie, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April	620	20	201	12,000
May	3,490	292	1,340	82,000
June	4,280	1,640	3,000	179,000
July	3,260	270	1,290	79,300
August	780	79	190	11,700
September	118	60	90.6	5,390
The period				370,000

LITTLE LARAMIE RIVER NEAR FILMORE, WYO.

LOCATION.—In sec. 9, T. 15 N., R. 77 W., at private bridge at May's ranch, 1½ miles south of Filmore, Albany County. No important tributary between station and junction of North, Middle, and South forks, 4 miles above.

DRAINAGE AREA.—155 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—July 5, 1902, to August 15, 1903; May 14, 1911, to October 31, 1912; April 1, 1915, to September 30, 1917. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Vertical staff on downstream side of left bridge abutment; read by Claude May. Gage used since April 1, 1915, was referred to datum 0.21 foot lower than gage, at same location, used during 1911 and 1912.

DISCHARGE MEASUREMENTS.—Made from single-span bridge or by wading.

CHANNEL AND CONTROL.—Channel composed of coarse gravel and small boulders; shifted slightly during 1917. No well-defined control. During high water there is flow through channel around right end of bridge.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.7 feet at 7 a. m. June 23 and 5 a. m. June 25 (discharge, 1,920 second-feet); minimum stage probably occurs during winter.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 43 second-feet from the Little Laramie above station, and 255 second-feet from tributaries entering above.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by ice during winter. Rating curve used October 1 to November 7 fairly well defined between 20 and 200 second-feet; curve used April 15 to July 31 well defined between 20 and 1,800 second-feet; shifting-control method used August 1 to September 30. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to the rating table. Records good.

Discharge measurements of Little Laramie River near Filmore, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 18	H. W. Fear	2.04	231	July 28	S. B. Soulé	2.04	233
June 20	Robert Follansbee	4.42	1,700	Sept. 13	.....do	1.00	38.0

Daily discharge, in second-feet, of Little Laramie River near Filmore, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	20	19		63	323	1,220	192	52
2	19	19		76	268	1,070	157	50
3	21	19		77	251	930	146	47
4	26	19		80	285	930	136	46
5	27	19		80	323	930	146	46
6	26	19		54	323	930	136	48
7	26	18		68	344	930	117	56
8	37			67	651	832	108	50
9	30			87	770	800	99	44
10	30			94	1,070	740	107	41
11	31			148	1,140	865	99	42
12	27			159	1,000	770	99	44
13	28			128	930	566	91	37
14	26			138	930	512	91	36
15	26		66	170	1,140	460	91	36
16	25		56	208	1,370	411	91	37
17	23		75	236	1,520	388	90	37
18	23		80	251	1,680	365	90	34
19	25		79	268	1,680	365	90	32
20	27		56	388	1,680	460	90	32
21	29		75	365	1,680	365	76	32
22	29		80	268	1,680	323	68	31
23	32		87	236	1,840	323	68	30
24	38		102	251	1,600	323	62	30
25	41		87	285	1,680	388	60	31
26	47		102	285	1,600	323	56	34
27	39		87	268	1,520	285	74	34
28	28		48	251	1,370	268	74	34
29	26		43	251	1,370	236	70	33
30	23		44	268	1,760	208	59	31
31	20			365		208	53	

NOTE.—Oct. 19-21, stage-discharge relation affected by anchor ice; discharge interpolated.

Monthly discharge of Little Laramie River near Filmore, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	47	19	28.2	1,730
November 1-7	19	18	18.9	262
April 15-30	102	43	72.9	2,310
May	388	54	191	11,700
June	1,840	251	1,130	67,200
July	1,220	208	572	35,200
August	192	53	96.3	5,920
September	56	30	38.9	2,310

LITTLE LARAMIE RIVER AT TWO RIVERS, WYO.

LOCATION.—On line between secs. 5 and 6, T. 17 N., R. 74 W., at highway bridge half a mile south of Two Rivers, Albany County. No tributary between station and mouth, half a mile below.

DRAINAGE AREA.—310 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 6, 1911, to October 31, 1912; October 1, 1913, to August 18, 1917. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Bristol water-stage recorder at bridge. Gage used during 1913 and 1914 was 400 feet downstream and referred to different datum.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel which is fairly permanent. Control not well defined. Banks not likely to be overflowed, except during extremely high water.

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder, 6.0 feet at noon June 25 (discharge, 1,390 second-feet); minimum discharge occurs during irrigation season when there is little or no flow for extended periods.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions from Little Laramie River of 422 second-feet between station near Filmore and this station; none below station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice during winter. Rating curve well defined below 1,200 second-feet. The operation of the water-stage recorder was satisfactory. Daily discharge ascertained by applying to the rating table the mean daily gage-height determined by inspecting the gage-height graph. Records good.

Discharge measurements of Little Laramie River at Two Rivers, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 30	H. K. Smith	2.96	111	July 29	S. B. Soulé	3.00	117
June 21	Robert Follansbee	5.51	1,140	Sept. 15	.....do	1.43	1.7

Daily discharge, in second-feet, of Little Laramie River at Two Rivers, Wyo., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Day.	Apr.	May.	June.	July.	Aug.
1		138	360	772	105	16	98	66	525	360	15
2		150	302	750	84	17	98	60	682	302	14
3		176	204	570	66	18	91	55	795	285	16
4		189	112	400	55	19	98	55	915	251	
5		189	78	285	45	20	98	84	1,060	251	
6		150	78	251	41	21	112	285	1,120	268	
7		112	78	460	37	22	105	440	1,120	285	
8		105	98	592	30	23	91	219	1,090	235	
9		98	150	592	29	24	78	150	1,190	204	
10		91	285	548	27	25	78	150	1,220	204	
11		84	502	592	25	26	78	440	1,160	219	
12		98	728	940	23	27	55	592	1,160	219	
13		98	795	890	22	28	60	285	1,090	176	
14		84	705	525	18	29	105	150	984	129	
15		66	480	420	16	30	105	102	878	129	
						31		268		138	

Monthly discharge of Little Laramie River at Two Rivers, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 16-30	112	55	90.0	2,680
May	592	55	171	10,500
June	1,220	78	665	39,600
July	940	129	395	24,300
Agust 1-18	105	14	37.1	1,320
September 15-22	2	1	1.5	24

NORTH LARAMIE RIVER NEAR WHEATLAND, WYO.

LOCATION.—In sec. 2, T. 25 N., R. 70 W., a quarter of a mile above head gate of North Laramie Land Co.'s ditch and 18 miles northwest of Wheatland, Platte County. No important tributary within 10 miles of station.

DRAINAGE AREA.—366 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—November 6, 1914, to Sėptember 30, 1917.

GAGE.—Bristol water-stage recorder at left bank on vertical cliff just below proposed dam site.

DISCHARGE MEASUREMENTS.—Made from cable near gage or by wading.

CHANNEL AND CONTROL.—Channel of sand and gravel. Control 40 feet downstream at rapids which shifted slightly during 1917.

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder, 4.05 feet June 2 (discharge, 1,270 second-feet); minimum stage probably occurred during winter.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 37 second-feet from North Laramie River, above station, and 27 second-feet below.

REGULATION.—None.

ACCURACY.—Stage-discharge relation shifts between narrow limits; affected by ice during winter. Rating curve well defined below 1,000 second-feet. Operation of the water-stage recorder was fairly satisfactory except for short intervals as explained in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table the mean daily gage height determined by inspecting gage-height graph, except for periods March 7 to April 20 and June 1 to September 5, when discharge was determined by shifting-control method. Records good up to 1,000 second-feet, above which they are fair.

Discharge measurements of North Laramie River near Wheatland, Wyo., during the year ending Sept. 30, 1917.

[Made by P. V. Hodges.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Mar. 31	1.02	22.9	May 23	3.45	849	Sept. 12	0.91	16.4
May 1	1.92	170	Aug. 6	1.02	27.2			

Daily discharge, in second-feet, of North Laramie River near Wheatland, Wyo., for the year ending Sept. 30, 1917.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		43	153	1,190	172	29	20
2		44	141	1,270	160	29	17
3		30	190	1,030	160	29	20
4		29	230	1,110	160	29	20
5		37	260	1,110	137	29	20
6		37	245	958	137	29	20
7	11	29	260	854	126	29	16
8	11	39	245	789	115	25	16
9	15	111	215	724	105	25	16
10	15	299	202	659	105	25	16
11	15	319	275	576	105	25	16
12	11	376	400	496	105	25	16
13	10	560	465	388	105	22	16
14	10	396	592	330	105	22	16
15	13	302	848	348	105	25	16
16		212	950	330	95	25	16
17		188	950	296	86	25	16
18		163	880	281	86	25	16
19		163	815	266	86	29	16
20		151	1,100	251	78	25	16
21		178	1,100	254	70	25	16
22		245	880	254	56	25	16
23		400	815	239	56	25	14
24		510	950	224	44	25	12
25		322	950	224	34	25	20
26		275	1,260	210	29	24	16
27	15	215	1,100	224	29	24	16
28	13	141	1,100	224	25	24	16
29	18	141	1,100	224	25	24	16
30	25	141	1,260	198	29	20	16
31	22		1,180		22	20	

NOTE.—Sept. 8-11, no gage-height record, as water-stage recorder was out of order; discharge interpolated.

Monthly discharge of North Laramie River near Wheatland, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April	560	29	203	12,100
May	1,260	141	681	41,900
June	1,270	198	518	30,800
July	172	22	88.8	5,460
August	29	20	25.4	1,560
September	20	12	16.6	988

CHUGWATER CREEK AT CHUGWATER, WYO.

Location.—In sec. 31, T. 21 N., R. 66 W., 300 feet above highway bridge half a mile from railroad station at Chugwater, Platte County. No tributary within several miles.

Drainage area.—359 square miles (measured on base map of Wyoming; scale, 1:500,000).

Records available.—May 22, 1911, to November 6, 1912; January 1, 1915, to September 30, 1917. State engineer maintained station at this point during 1913 and 1914.

Gage.—Chain gage on left bank 300 feet above bridge, installed April 6, 1916, at same datum and location as vertical staff previously used; read by Artie Allen. Prior to February 6, 1912, gage was on bridge and referred to different datum.

Discharge measurements.—Made from highway bridge or by wading.

Channel and control.—Bed composed of sand which shifted considerably during 1917. Control not well defined. Banks high and not subject to overflow.

Extremes of discharge.—Maximum stage recorded during year, 3.4 feet at 4 p. m. June 1 (discharge, 280 second-feet); minimum stage, 1.06 feet on January 26, 27, 29–31 (discharge, 2.6 second-feet).

Ice.—Stage-discharge relation not affected by ice, except for short periods.

Diversions.—Prior to December 31, 1916, there were adjudicated diversions from Chugwater Creek of 73 second-feet above station, and 98 second-feet below.

Regulation.—None.

Accuracy.—Stage-discharge relation not permanent; not affected by ice during winter. Rating curve used October 1 to December 31 fairly well defined below 200 second-feet, and curve used June 2 to September 30 is faily well defined between 10 and 250 second-feet; shifting-control method used January 1 to June 1. Gage read to hundredths twice daily. Daily discharge ascertained by applying the mean daily gage height to rating table. Records good, except for period May 24 to June 4, when they are only fair because of a decided shift.

Discharge measurements of Chugwater Creek at Chugwater, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 25	H. K. Smith	1.08	2.8	Aug. 7	P. V. Hodges	1.10	15.1
Apr. 30	P. V. Hodges	2.38	66	7	.....do	1.10	15.2
May 24	.....do	3.06	143	Sept. 11	.....do	1.17	13.4
June 5	.....do	3.28	230				

Daily discharge, in second-feet, of Chugwater Creek at Chugwater, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	3.0	3.5	3.7	3.5	2.7	5.9	18	67	275	29	23	24
2	3.0	3.5	3.9	3.7	2.7	6.0	16	67	258	26	14	20
3	4.0	3.5	4.8	3.7	2.7	6.6	28	67	245	39	14	19
4	5.1	3.5	5.8	3.7	2.8	5.6	21	63	245	29	20	15
5	5.1	3.5	6.3	3.5	2.8	6.0	24	54	245	26	36	15
6	5.1	3.5	7.6	3.5	3.1	8.8	23	59	233	22	20	16
7	5.1	3.5	3.7	3.5	3.1	6.6	20	59	209	22	15	16
8	3.4	3.5	4.4	3.7	3.1	5.3	18	59	209	20	16	17
9	3.4	3.5	3.9	3.5	3.2	6.8	19	51	197	19	15	22
10	3.4	3.5	3.9	3.0	3.0	8.8	24	51	197	17	12	18
11	3.4	3.5	4.6	3.1	3.1	9.4	32	51	173	19	13	20
12	3.5	3.5	4.0	3.0	3.1	7.8	40	48	149	19	13	18
13	3.5	3.5	4.4	3.0	3.1	7.6	39	52	126	16	14	26
14	3.5	3.5	4.6	3.0	3.5	9.1	39	61	120	12	27	21
15	3.5	3.5	4.4	3.0	4.6	10.7	47	86	110	12	20	20
16	3.5	3.5	4.4	3.0	3.9	5.1	47	118	100	11	20	22
17	3.5	3.5	4.6	2.7	3.9	5.6	47	157	90	11	16	16
18	3.7	3.5	4.4	2.8	3.9	8.1	43	181	85	11	20	20
19	3.7	3.5	4.0	2.8	3.9	11.9	55	147	76	10	20	17
20	3.5	3.5	4.0	2.8	4.2	9.1	59	147	67	11	22	20
21	3.5	3.5	4.0	2.8	4.6	9.1	50	172	58	11	19	17
22	3.5	3.4	4.2	2.8	5.3	11.6	46	172	54	12	22	20
23	3.5	3.4	4.0	2.8	5.8	7.6	46	148	54	10	22	20
24	3.5	3.4	4.0	2.7	6.8	10.0	55	148	50	12	22	16
25	3.5	3.4	4.0	2.8	11.3	11.0	82	148	48	17	23	17
26	3.5	3.4	4.2	2.6	8.4	12	92	205	44	26	20	16
27	3.5	3.9	3.9	2.6	7.3	13	97	227	40	23	19	20
28	3.5	4.0	4.0	2.7	5.8	14	82	213	41	26	20	20
29	3.5	3.9	4.0	2.6	......	15	67	208	35	23	22	15
30	3.5	3.9	3.9	2.6	......	16	67	229	31	20	24	20
31	3.5	......	3.5	2.6	......	17	......	263	......	23	22	......

Monthly discharge of Chugwater Creek at Chugwater, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	5.1	3.0	3.69	227
November	4.0	3.4	3.54	211
December	7.6	3.5	4.36	268
January	3.7	2.6	3.04	187
February	11.3	2.7	4.35	242
March	17.0	5.1	9.26	569
April	97	16	44.8	2,670
May	263	48	122	7,500
June	275	31	129	7,680
July	39	10	18.8	1,160
August	36	12	19.5	1,200
September	26	15	18.8	1,120
The year	275	2.6	31.8	23,000

HORSE CREEK NEAR LA GRANGE, WYO.

Location.—In SW. ¼ SW. ¼ sec. 34, T. 20 N., R. 61 W., 2 miles southeast of Wye-Cross ranch and 1½ miles northwest of La Grange, Goshen County. Nearest tributary, Bear Creek, enters 2 miles below.

Drainage area.—683 square miles (measured on base map of Wyoming; scale, 1:500,000).

Records available.—November 1, 1915, to September 30, 1917. From December 1, 1911, to December 31, 1912, fragmentary records are available at a point 1½ miles downstream.

Gage.—Gurley water-stage recorder on left bank.

Discharge measurements.—Made from footbridge near gage or by wading.

Channel and control.—Bed composed of coarse gravel which may shift. Control just below station at small rapids; practically permanent during 1917.

Extremes of discharge.—Maximum stage during year from water-stage recorder, 3.2 feet at 1 a. m. June 3 (discharge, 345 second-feet); minimum stage from water-stage recorder, 0.85 foot on October 1, 2, and 3 (discharge, 9 second-feet).

Ice.—Stage-discharge relation not seriously affected by ice except during short periods.

Diversions.—Prior to December 31, 1916, there were adjudicated permits for diversions of 1,163 second-feet from Horse Creek above station, and 71 second-feet below. In addition, there were permits for 2,067 acre-feet storage above, and 5,202 acre-feet below station.

Regulation.—None.

Accuracy.—Stage-discharge relation practically permanent; affected by snow and ice for short periods during winter. Rating curve well defined between 6 and 280 second-feet. Operation of the water-stage recorder was satisfactory throughout year, except for short periods indicated by breaks in record, as shown in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage height determined by inspecting gage-height graph. Records excellent, except for periods affected by ice when they are fair.

Discharge measurements of Horse Creek near La Grange, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 25	Robert Follansbee	1.10	20.6	June 5	P. V. Hodges	2.67	218
Feb. 28	H. K. Smith	1.28	38.9	Sept. 24	Robert Follansbee	1.29	32.8
June 5	P. V. Hodges	2.83	254				

Daily discharge, in second-feet, of Horse Creek near La Grange, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	9	18	33	27	48	41	59	25	320	39	14	36
2	9	18	35	28	39	48	51	32	332	37	12	35
3	9	18	33	29	31	47	41	36	320	37	10	34
4	9	18	33	29	23	49	32	31	269	37	9	34
5	9	18	32	30	22	40	32	21	246	34	12	35
6	9	18	32	32	23	44	30	17	244	30	21	38
7	10	17	26	32	26	49	29	16	222	29	20	39
8	10	18	23	33	27	54	28	14	209	27	20	40
9	11	18	24	34	30	56	27	14	182	27	20	57
10	11	18	28	32	38	62	27	14	154	26	20	55
11	12	14	31	35	39	69	32	14	145	18	21	54
12	14	17	29	35	41	49	32	12	139	14	20	58
13	21	20	29	32	46	55	29	13	133	14	21	53
14	22	23	34	29	43	57	25	14	118	14	21	43
15	23	26	37	27	43	49	23	14	91	15	22	42
16	24	29	32	22	50	38	24	16	72	15	22	41
17	23	33	27	24	45	28	24	29	68	16	21	41
18	21	37	28	26	43	34	24	29	62	17	21	41
19	22	34	33	28	41	66	24	32	57	17	21	41
20	21	30	32	30	41	80	26	53	41	18	22	40
21	23	29	32	29	45	73	37	78	29	17	23	38
22	23	29	33	28	47	74	32	88	22	18	24	37
23	24	32	31	26	52	60	21	104	17	17	23	35
24	24	35	31	24	51	64	17	102	18	17	22	36
25	23	30	30	22	76	64	16	99	17	17	24	36
26	23	34	29	21	77	57	14	129	28	16	25	36
27	23	34	30	20	75	63	15	179	78	17	27	38
28	22	32	26	23	50	72	17	276	62	16	27	36
29	21	25	25	26	....	69	18	308	60	14	37	35
30	20	27	26	31	....	68	20	295	47	13	41	37
31	20	....	26	35	....	64	....	320	....	16	38	....

Note.—Nov. 12-17, Jan. 17-19, 22-26, no gage-height record as water-stage recorder was out of order; discharge interpolated. Dec. 15, 17-18, 20-30, Jan. 4-5, 13-16, 21, Mar. 6-9, and 16, stage-discharge relation affected by snow and ice; discharge based on temperature and gage-height record and observer's notes.

Monthly discharge of Horse Creek near La Grange, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	24	9	17.6	1,080
November	37	14	25.0	1,490
December	37	23	30.0	1,840
January	35	20	28.4	1,750
February	77	22	43.3	2,400
March	80	28	56.3	3,460
April	59	14	27.5	1,640
May	320	12	78.2	4,810
June	332	17	127	7,560
July	39	13	21.3	1,310
August	41	9	22.0	1,350
September	57	34	40.6	2,420
The year	332	9	42.9	31,100

SOUTH PLATTE RIVER AT SOUTH PLATTE, COLO.

LOCATION.—In sec. 25, T. 7 S., R. 70 W., 375 feet below point where North Fork of South Platte enters, at South Platte, Jefferson County. No tributary between forks and station.

DRAINAGE AREA.—2,610 square miles (measured on map in Hayden's atlas).

RECORDS AVAILABLE.—March 28, 1902, to September 30, 1917. Records at Platte Canyon and at Deansbury, a few miles below, extend back to 1887, with the exception of 1893 and 1894. The earlier records, 1887–1892, were taken by the State engineer, and records from 1895 to 1896 were taken under direction of the Denver Power & Irrigation Co.

GAGE.—Bristol water-stage recorder on right bank 375 feet below forks; in use since March 14, 1910. From March 28, 1902, to May 7, 1905, the gage was at the highway bridge. On May 7, 1905, gage was moved to its present site 150 feet below bridge. Datum of new gage probably somewhat different. Recording gage is referred to datum of gage established in 1905.

DISCHARGE MEASUREMENTS.—Made from cable near gage or by wading.

CHANNEL AND CONTROL.—Bed composed of coarse sand and fine gravel; shifts. Control 35 feet downstream at well-defined rapids; shifts considerably at times. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder, 5.4 feet at 8.30 a. m., June 20 (discharge, 2,050 second-feet); minimum discharge occurs during winter.

ICE.—Stage-discharge relation seriously affected by ice; monthly mean discharge estimated from records obtained few miles below by Denver Union Water Co.

DIVERSIONS.—No water is diverted between this station and that on the North Fork at South Platte. Above the station there are court decrees for 85,600 and 80,000 acre-feet for Antero and Cheesman reservoirs, respectively, all of which passes the gage before being diverted. In addition to the reservoir decrees, there are decrees for diversions of 1,075 second-feet from South Platte River above station, and 3,326 second-feet from tributaries entering above. Also a decree for storage of 46,000 acre-feet in reservoir located on tributary entering above station.

REGULATION.—Flow regulated to certain extent by Antero and Cheesman reservoirs on the South Platte, 60 and 15 miles, respectively, above the forks.

ACCURACY.—Stage-discharge relation slightly shifting; affected by ice during winter. Rating curve used October 1 to 30 well defined between 75 and 800 second-feet; curve used April 1 to September 30 well defined between 100 and 1,600 second-feet. Water-stage recorder gave satisfactory results except for short periods as explained in the footnotes. Daily discharge ascertained by applying to rating table the mean daily gage height determined by inspecting gage-height graph. Records for October and April to September are good.

Discharge measurements of South Platte River at South Platte, Colo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 6	Robert Follansbee	1.68	113	Apr. 24	P. V. Hodges	2.06	267
Dec. 16	P. V. Hodges	2.10	184	May 26	H. W. Fear	4.08	1,250
Jan. 25	....Do	3.50	120	June 27	Robert Follansbee	4.44	1,400
Feb. 28	....Do	1.49	106	July 26	H. W. Fear	4.36	1,440
Apr. 19	Smith and Hodges	1.73	165	Aug. 16	Robert Follansbee	3.62	948
20	....Do	1.52	147				

Daily discharge, in second-feet, of South Platte River at South Platte, Colo., for the year ending Sept. 30, 1917.

Day.	Oct.	Apr.	May.	June.	July.	Aug.	Sept.
1	121	200	210	1,060	1,150	875	600
2	110	150	210	1,090	1,090	775	568
3	110	160	225	1,180	1,010	650	546
4	110	121	225	1,240	982	600	474
5	98	142	258	1,210	928	650	377
6	492	142	225	1,090	900	600	437
7	738	151	240	1,040	850	750	449
8	146	108	258	1,060	875	750	465
9	121	185	225	1,120	982	675	470
10	134	204	240	1,330	1,300	750	457
11	121	166	258	1,390	1,600	850	457
12	110	175	292	1,360	1,420	850	425
13	121	175	328	1,480	1,210	850	417
14	121	180	385	1,510	1,040	850	425
15	173	180	700	1,630	850	875	377
16	121	180	825	1,660	800	875	338
17	146	190	875	1,790	750	928	268
18	160	210	955	1,860	775	955	244
19	146	165	955	1,860	760	928	190
20	134	147	1,040	1,920	760	775	177
21	134	177	1,120	1,790	1,140	700	204
22	146	204	1,290	1,790	1,080	600	234
23	134	240	1,240	1,790	1,060	650	234
24	121	258	1,210	1,660	900	650	190
25	60	258	1,240	1,660	1,010	650	190
26	110	289	1,190	1,540	1,300	625	185
27	110	268	1,120	1,480	1,480	600	180
28	110	240	1,100	1,360	1,540	650	185
29	103	210	1,090	1,300	1,330	650	190
30	88	196	1,040	1,240	1,180	675	195
31	74	....	1,010	....	1,060	650	....

NOTE.—April 1-2, 12-20, July 19-23, Sept. 25-30, no gage-height record, as water-stage recorder was out of order. Discharge based on comparative hydrograph of South Platte River at Platte Canyon intake.

Monthly discharge of South Platte River at South Platte, Colo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	738	74	152	9,350
November	....	....	132	7,860
December	....	....	138	8,490
January	....	....	144	8,850
February	....	....	114	6,330
March	....	....	101	6,210
April	289	108	189	11,200
May	1,290	210	696	42,800
June	1,920	1,040	1,450	86,300
July	1,600	760	1,070	65,800
August	955	600	739	45,400
September	600	177	338	20,100
The year	1,920	....	440	319,000

NOTE.—Monthly estimates for November, December, January, February, and March taken from records of Union Water Co.

TARRYALL CREEK NEAR JEFFERSON, COLO.

LOCATION.—In sec. 6, T. 9 S., R. 74 W., at Robbins ranch, 10 miles southwest of Jefferson, Park County. Rock Creek enters half a mile below.

DRAINAGE AREA.—223 square miles (measured on Forest atlas).

RECORDS AVAILABLE.—June 27, 1912, to October 27, 1917. From October 18, 1910, to June 28, 1911, a station was maintained within a quarter of a mile of present site. Relation between the present gage and that used 1910–11 not known.

GAGE.—Vertical staff installed April 22, 1916, on left bank 60 feet above and at same datum as old vertical on left bank opposite ranch house. Difference in gage heights of about 0.4 foot as read on new and old gages is due to fall in stream between them; read by Miss Mary Robbins.

DISCHARGE MEASUREMENTS.—Made from footbridge 400 feet below gage or by wading.

CHANNEL AND CONTROL.—Bed composed of fine gravel. Principal control 150 feet downstream at gravel bar; practically permanent during 1917. Banks subject to overflow at stage of 2.8 feet, and at 3.0 feet the entire bottom for a width of 500 feet is flooded.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.1 feet at 7:15 p. m. July 9 (discharge, 1,320 second-feet); minimum stage, 0.45 foot October 3, 1917. (Discharge, 1.0 second-foot.)

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

DIVERSIONS.—There are court decrees for diversions of 314 second-feet from Tarryall Creek above and 220 second-feet below station. The Tarryall Canal and Reservoir Co. has a provisional decree for storage of 68,000 acre-feet from Tarryall and tributaries above station, and a decree for a supply diversion (not yet made) amounting to 450 second-feet. There are decrees for diversions of 926 second-feet from tributaries entering above station. The Boreas ditch diverts a small amount of water from the headwaters of Blue River to Tarryall Creek at its headwaters.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice during winter. Rating curves well defined between 10 and 350 second-feet; not well defined above 350 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good up to 350 second-feet, above which they are fair.

Discharge measurements of Tarryall Creek near Jefferson, Colo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 24	H. W. Fear	1.04	37.5	June 25	Robert Follansbee	1.81	206
25	.....do	.91	23.1	July 23	H. W. Fear	1.27	80

Daily discharge, in second-feet, of Tarryall Creek near Jefferson, Colo., for the period Oct. 1, 1916, to Oct. 27, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	15	26	....	30	137	181	105	28	5.0
2	16	25	....	39	105	159	105	22	3.0
3	13	24	....	51	32	137	111	35	1.0
4	16	24	....	53	12	137	111	26	2.2
5	12	26	....	39	10	126	148	20	3.8
6	16	25	....	32	7	137	126	18	5.0
7	13	25	....	34	13	137	137	39	5.0
8	7	20	....	34	10	400	137	95	5.0
9	13	23	....	25	10	1,320	115	35	5.4
10	16	24	....	85	12	480	115	32	6.2
11	10	25	....	216	28	238	111	28	3.0
12	8	....	....	159	45	170	91	18	2.7
13	9	....	....	148	85	137	111	18	3.8
14	12	....	....	69	137	89	111	25	3.0
15	32	....	....	34	216	73	126	13	3.0
16	36	....	126	39	250	95	148	22	3.0
17	46	....	105	34	250	109	216	13	2.7
18	52	....	99	28	250	181	238	13	3.0
19	54	....	101	31	250	228	216	13	2.7
20	51	....	53	113	273	170	181	13	2.7
21	38	....	73	216	296	148	65	12	3.0
22	58	....	85	59	238	148	111	10	6.2
23	37	....	87	53	204	99	119	8	8.2
24	29	....	77	35	204	159	99	7	10
25	41	....	79	22	181	216	32	10	12
26	46	....	81	12	204	411	51	8	15
27	37	....	53	10	204	273	45	8	20
28	51	....	37	12	181	115	59	10	....
29	36	....	23	18	159	126	51	10	....
30	32	....	41	12	159	137	45	10	....
31	19	....	....	20	....	148	39	....	....

Monthly discharge of Tarryall Creek near Jefferson, Colo., for the period Oct. 1, 1916, to Oct. 27, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	58	7	28.1	1,730
November 1-11	26	20	24.3	530
April 16-30	126	23	74.7	2,220
May	216	10	56.8	3,490
June	296	7	139	8,270
July	1,320	73	216	13,300
August	238	32	112	6,890
September	95	7	20.6	1,230
October 1-27	20	1.0	5.39	289

NORTH FORK OF SOUTH PLATTE RIVER AT GRANT, COLO.

Location.—In sec. 9, T. 7 S., R. 74 W., at Grant, Park County, 250 feet above mouth of Geneva Creek.

Drainage area.—51 square miles (measured on Forest atlas).

Records available.—July 18, 1910, to September 30, 1917.

Gage.—Vertical staff on left bank 250 feet above mouth of Geneva Creek; read by Mrs. M. McFarland.

Discharge measurements.—Made by wading.

Channel and control.—Bed composed of gravel. Principal control about 20 feet below gage at small rapids; shifted during 1917.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.18 feet at 6 p.m. June 10 (discharge, 233 second-feet); minimum discharge occurs during winter.

ICE.—Stage-discharge relation serioulsy affected by ice; observations discontinued during winter; discharge measurements made monthly.

DIVERSIONS.—There are court decrees for diversions of 5.5 second-feet from the North Fork above station and 24 second-feet from tributaries entering above.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by ice during winter. Rating curve fairly well defined below 160 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except for period April 1 to September 30, when discharge is computed by shifting-control method. Records fair.

Discharge measurements of North Fork of South Platte River at Grant, Colo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 9	P. V. Hedges	a 1.88	10.5	May 11	H. W. Fear	1.68	15.0
Dec. 15	.....do	a 2.30	8.6	July 24	.....do	2.05	63
Jan. 24	.....do	a 2.50	5.6	25	.....do	2.04	62
Feb. 26	.....do		5.8	Aug. 15	Robert Follansbee	1.78	29.3

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of North Fork of South Platte River at Grant, Colo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	9	7	0.5	13	75	129	50	17
2	9	7	.4	14	84	122	46	16
3	8	7	.4	11	86	122	44	13
4	7	11	.6	11	88	107	41	14
5	7	9	.8	11	95	107	40	15
6	9	7	.4	20	95	100	38	13
7	12	7	.4	19	96	93	38	14
8	8	8	11	17	132	100	31	13
9	11	10	14	20	148	122	34	13
10	7	....	13	17	218	107	31	13
11	7	....	12	15	218	100	31	12
12	7	....	11	20	202	92	29	12
13	7	....	11	28	220	88	35	12
14	7	....	11	42	186	82	29	14
15	9	....	8.2	50	195	64	26	13
16	11	....	8.2	53	195	68	28	12
17	12	....	7.0	68	195	70	26	12
18	11	....	8.8	79	195	68	26	11
19	6	....	7.0	86	186	68	26	11
20	7	....	7.0	76	177	67	25	11
21	8	....	12	79	177	65	23	11
22	9	....	22	73	161	62	22	10
23	9	....	26	67	161	61	22	9
24	9	....	23	69	161	61	22	9
25	9	....	22	70	161	76	20	8
26	9	....	21	69	153	70	19	8
27	8	....	20	57	145	61	19	8
28	8	....	14	69	145	55	20	8
29	8	....	15	68	145	57	19	8
30	7	....	26	69	129	62	19	8
31	7	....	....	73	....	54	17	....

Monthly discharge of North Fork of South Platte River at Grant, Colo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	12	6	8.45	520
November 1-9	11	7	8.11	145
April	26	.4	11.1	660
May	86	11	46.2	2,840
June	220	75	154	9,160
July	129	54	82.6	5,080
August	50	17	28.9	1,780
September	17	8	11.6	690

NORTH FORK OF SOUTH PLATTE RIVER AT SOUTH PLATTE, COLO.

LOCATION.—In sec. 25, T. 3 S., R. 70 W., one-third of a mile above railroad station at South Platte, Jefferson County. No tributary between station and mouth at South Platte.

DRAINAGE AREA.—449 square miles (measured on map in Hayden's atlas).

RECORDS AVAILABLE.—January 4, 1909, to September 30, 1910; April 1, 1913, to September 30, 1917.

GAGE.—Inclined staff on left bank one-third of a mile above railroad station; read by Mrs. Mata Wallbrecht.

DISCHARGE MEASUREMENTS.—Made from cable 300 feet above gage or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and sand. Principal control a short distance below gage; shifting between narrow limits. Banks not subject to much overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.8 feet at 8 a. m. June 18 (discharge, 1,300 second-feet); minimum discharge occurs during winter.

ICE.—Stage-discharge relation seriously affected by ice; daily discharge not determined because of insufficient data.

DIVERSIONS.—There are court decrees for diversion of 20 second-feet from North Fork between Grant and South Platte, and 62 second-feet from intervening tributaries, exclusive of Geneva Creek. Small quantities of water are also diverted at various times for several small ice and fish ponds.

REGULATION.—None.

ACCURACY.—Stage-discharge relation slightly shifting; affected by ice during winter. Rating curve used October 1 to November 10 well defined between 25 and 200 second-feet; curve used March 25 to September 30 well defined between 60 and 900 second-feet. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table; shifting-control method used October 1 to November 10. Records fair, October 1 to November 10; good, March 25 to September 30.

Discharge measurements of North Fork of South Platte River at South Platte, Colo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 6	Robert Follansbee	1.82	61	May 26	H. W. Fear	3.28	498
Dec. 16	P. V. Hodges	[a] 2.30	50	June 27	Robert Follansbee	3.95	540
Jan. 25	.....do	....	38	July 25	H. W. Fear	2.90	375
Feb. 28	.....do	[a] 2.25	45.5	Aug. 16	Robert Follansbee	2.30	167
Apr. 19	Smith and Hodges	1.98	104				

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of North Fork of South Platte River at South Platte, Colo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	82	66		65	136	552	620	260	102
2	82	66		30	124	552	575	230	120
3	82	59		65	136	552	575	230	106
4	82	55		35	136	575	485	202	92
5	85	61		65	148	645	508	230	92
6	80	56		78	120	575	485	230	92
7	85	43		58	148	575	485	174	102
8	70	33		76	161	575	530	174	98
9	87	30		88	148	620	530	174	102
10	87	17		98	161	820	645	174	92
11	87			88	161	948	530	174	86
12	76			78	174	895	440	188	82
13	72			98	202	920	420	202	82
14	76			88	230	975	400	188	86
15	136			94	342	1,030	360	202	102
16	98			78	360	1,060	360	188	92
17	123			82	485	1,140	325	202	82
18	102			98	530	1,140	308	188	82
19	100			98	508	1,110	325	174	82
20	85			74	552	1,110	342	174	82
21	85			102	530	1,000	290	148	82
22	85			120	530	948	290	148	82
23	98			148	485	948	290	148	82
24	80			148	530	870	290	148	78
25	94		82	174	530	845	400	136	72
26	100		52	202	530	820	325	174	78
27	100		40	174	530	795	400	174	86
28	100		78	136	508	695	308	148	78
29	91		82	120	485	695	290	148	67
30	76		124	106	485	670	290	136	67
31	76		120		530		308	120	

Monthly discharge of North Fork of South Platte River at South Platte, Colo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	136	70	89.1	5,480
November 1-10	66	17	48.6	964
March 25-31	124	40	82.6	1,150
April	202	30	98.8	5,880
May	552	120	343	21,100
June	1,140	552	822	48,900
July	645	290	411	25,300
August	260	120	180	11,100
September	120	67	87.6	5,210

GENEVA CREEK AT GRANT, COLO.

Location.—In sec. 9, T. 7 S., R. 74 W., just below highway bridge at Grant, Park County, 300 feet above mouth of creek.

Drainage area.—74 square miles (measured on map in Forest atlas).

Records available.—November 3, 1911, to September 30, 1917. From July 5, 1908, to November 3, 1911, a station was maintained at Sullivan's ranch 3 miles above Grant. Except during the spring run-off, the flow at the two points is practically the same.

Gage.—Vertical staff on right bank just below bridge; temporary vertical staff on downstream side of left abutment used November 8, 1916, to May 5, 1917; read by Mrs. M. McFarland.

Discharge measurements.—Made from single-span bridge or by wading.

Channel and control.—Bed composed of coarse gravel. Principal control 50 feet downstream at gravel bar; shifted during high water of 1917. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.1 feet at 6 p. m. June 17 (discharge, 546 second-feet); minimum discharge of 10 second-feet occurred in February, March, and April.

ICE.—Stage-discharge relation seriously affected by ice; flow estimated from discharge measurements, observer's notes, and records of temperature.

DIVERSIONS.—There is a court decree for diversions of 1 second-foot from Geneva Creek above station, and a temporary reservoir decree for 1,490 acre-feet from Geneva and Kerby creeks.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by ice during winter. Rating curve well defined between 10 and 350 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying to rating table the mean daily gage height, except for period June 10 to August 7, when discharge is computed by shifting-control method. Records excellent, except for high water and period when stage-discharge relation is affected by ice, when they are fair.

Discharge measurements of Geneva Creek at Grant, Colo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 8	P. V. Hodges	1.00	18.3	May 10	H. W. Fear	1.16	28.8
9	.....do	1.06	22.0	June 25	Robert Follansbee	2.54	319
Dec. 15	.....do	a 1.22	21.1	July 25	H. W. Fear	1.93	172
Jan. 23	.....do	a 1.28	11.4	Aug. 15	Robert Follansbee	1.54	68
Feb. 26	.....do	.80	11.7				

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Geneva Creek at Grant, Colo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	30	23	28	18	11	10	12	17	76	301	121	37
2	30	23	25	18	10	10	11	19	86	266	104	33
3	30	25	16	18	10	10	11	16	89	252	106	32
4	30	24	15	18	11	10	14	14	116	219	97	33
5	28	24	15	18	11	10	17	13	18	222	95	34
6	28	22	14	18	11	10	10	16	106	191	87	32
7	28	20	13	18	11	11	14	22	106	209	78	33
8	27	18	13	18	11	12	11	23	132	242	72	31
9	28	22	12	18	11	12	12	19	167	280	70	30
10	27	21	13	18	11	12	14	20	283	301	72	30
11	27	21	13	18	11	12	13	23	280	252	68	30
12	27	19	15	17	11	12	12	23	298	219	70	30
13	27	18	17	15	11	12	14	34	266	200	68	30
14	27	12	18	13	11	12	14	56	400	185	68	30
15	23	13	21	13	10	12	13	76	495	206	68	30
16	30	16	21	15	12	12	13	95	472	159	72	30
17	30	17	21	16	11	28	12	116	487	153	68	28
18	35	18	21	16	11	24	15	132	468	156	61	28
19	23	19	21	16	12	16	13	109	464	173	62	27
20	29	21	21	15	11	15	14	66	442	156	61	27
21	29	24	21	13	11	12	15	82	423	148	56	27
22	28	24	21	12	10	12	27	70	400	159	53	26
23	30	25	21	12	10	10	23	72	381	156	55	25
24	32	28	21	12	10	13	35	82	415	182	48	25
25	19	35	21	12	10	10	25	76	396	182	46	25
26	18	37	18	12	10	10	27	72	345	173	44	25
27	18	35	17	11	10	10	24	82	345	170	46	25
28	19	31	17	11	10	11	17	78	330	153	46	25
29	20	31	18	11	....	12	19	74	312	148	45	25
30	21	37	18	11	....	12	19	74	298	145	45	24
31	22	....	18	11	....	14	....	73	....	137	40	....

NOTE.—Oct. 27–31, no gage-height record; discharge interpolated. Nov. 9–20, 22, 24, 27, Dec. 1, 6–Feb. 13, 28–Mar. 12 stage-discharge relation affected by ice; discharge based on temperature and gage-height records, discharge measurements, and observer's notes.

Monthly discharge of Geneva Creek at Grant, Colo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	35	18	26.5	1,630
November	37	12	23.4	1,390
December	28	12	18.2	1,120
January	18	11	14.9	916
February	12	10	10.7	594
March	28	10	12.5	769
April	35	10	16.3	970
May	132	13	56.3	3,460
June	495	76	300	17,900
July	301	137	197	12,100
August	121	40	67.5	4,150
September	37	24	28.9	1,720
The year	495	10	64.5	46,700

CLEAR CREEK NEAR GOLDEN, COLO.

Location.—In sec. 6, T. 4 S., R. 70 W., 1,000 feet below head gates of Golden ditch and 2 miles above Golden, in Jefferson County. Only important tributary between station and mouth, Ralston Creek, enters 12 miles below.

Drainage area.—Approximately 380 square miles.

Records available.—December 4, 1908, to December 31, 1909; June 8 to September 24, 1911; January 29, 1912, to September 30, 1917.

Gage.—Lallie water-stage recorder on left bank 1,000 feet below head of Golden ditch.

Discharge measurements.—Made from cable near gage or by wading.

Channel and control.—Bed composed of coarse gravel and small boulders. Principal control 25 feet downstream at rapids; shifts occasionally. Creek flows in canyon; banks not subject to overflow.

Extremes of discharge.—Maximum stage during year from water-stage recorder, 4.8 feet at 4 a. m. June 18 (discharge, 1,670 second-feet); minimum discharge occurs during winter.

Ice.—Stage-discharge relation seriously affected by ice; observations discontinued during winter, except for occasional discharge measurements.

Diversions.—There is a court decree for a diversion of 53 second-feet from the headwaters of Fraser River to the West Fork of Clear Creek, and approximately 570 acre-feet were diverted in 1917 between July 7 and August 25. Above the Golden station there is a court decree for a diversion of 26 second-feet by the Golden ditch. The diversion by this ditch past the Clear Creek gaging station was about 6,000 acre-feet for 1917.

Regulation.—None.

Accuracy.—Stage-discharge relation not permanent; affected by ice during winter. Rating curve used October 1 to November 7 well defined between 50 and 600 second-feet; curve used March 29 to September 30 well defined between 40 and 1,000 second-feet. Operation of the water-stage recorder was satisfactory. Daily discharge ascertained by applying to rating table the mean daily gage height determined by inspecting gage-height graph, except for periods October 1 to November 7, and March 29 to July 31, when discharge was computed by indirect method for shifting control. Records good.

Discharge measurements of Clear Creek near Golden, Colo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 28	Fear and Hodges	a 1.50	51	July 9	Fear and Follansbee	3.62	881
Jan. 30	Hodges and Smith	a 1.12	60	19	P. V. Hodges	2.94	643
Mar. 5	.....do	.95	45.1	Aug. 15	.....do	2.08	256
Apr. 25	H. W. Fear	1.31	112	22	Hodges and Fear	1.84	204
25	.....do	1.28	100	22	.....do	1.85	209

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Clear Creek near Golden, Colo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	119	91	45	45	45	75	115	426	1,180	442	144
2	121	123	45	45	35	60	116	442	1,090	406	122
3	118	125	45	45	35	52	115	474	1,000	376	120
4	116	93	45	45	40	40	107	538	971	362	120
5	112	94	45	45	45	50	122	574	944	341	118
6	175	86	45	55	40	61	111	551	938	334	104
7	152	81	55	55	35	64	118	528	883	327	104
8	90	....	60	60	45	71	118	569	938	299	106
9	89	....	55	60	55	76	107	636	910	282	102
10	94	....	60	60	60	82	128	810	976	282	109
11	93	....	65	55	45	79	140	938	932	236	102
12	102	....	50	55	40	76	152	910	861	243	96
13	108	....	45	50	40	88	175	993	820	254	99
14	107	....	45	45	50	78	232	1,040	780	274	102
15	135	....	45	45	60	67	316	1,130	735	254	100
16	125	....	45	50	45	86	387	1,270	690	257	97
17	144	....	45	50	50	88	457	1,330	650	250	92
18	150	....	50	50	50	97	528	1,450	636	278	93
19	150	....	50	50	55	86	502	1,450	646	268	96
20	143	....	50	45	55	54	520	1,300	720	243	91
21	136	....	45	50	60	59	492	1,440	623	212	86
22	129	....	40	60	60	76	470	1,350	574	197	91
23	125	....	40	60	45	107	442	1,440	596	209	83
24	121	....	40	60	40	124	450	1,440	665	212	78
25	112	....	45	55	40	124	470	1,440	685	206	83
26	112	....	45	50	35	138	438	1,370	685	218	78
27	109	....	50	55	40	144	426	1,340	636	209	80
28	121	....	50	50	75	113	430	1,280	546	229	82
29	195	....	50	....	106	115	410	1,300	515	200	82
30	125	....	60	....	106	115	410	1,240	510	172	83
31	133	....	50	....	85	....	434	....	492	150	....

NOTE.—Records of daily discharge Jan. 1 to Mar. 28 furnished by the Farmers Reservoir & Irrigation Co.

Monthly discharge of Clear Creek near Golden, Colo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	195	89	124	7,620
November			63.9	3,800
December			49.5	3,040
January			48.5	2,980
February			51.8	2,880
March			52.2	3,210
April	144	40	84.8	5,050
May	528	107	304	18,700
June	1,450	426	1,030	61,300
July	1,180	492	769	47,300
August	442	150	265	16,300
September	144	78	98.4	5,860
The year	1,450		246	178,000

NOTE.—Determination of discharge for November and December based on temperature records and discharge measurement.

NORTH BOULDER CREEK AT SILVER LAKE, COLO.

LOCATION.—In NW. ¼ sec. 28, T. 1 N., R. 73 W., at outlet of Silver Lake, in Colorado National Forest.

DRAINAGE AREA.—8.7 square miles (measured by special survey).

RECORDS AVAILABLE.—August 20, 1913, to September 30, 1917.

GAGE.—Friez water-stage recorder which indicates head on the weir.

DISCHARGE MEASUREMENTS.—Made by means of standard sharp-crested weir 10 feet long having a low-water section 5 feet long.

DIVERSIONS.—None above station.

REGULATION.—Winter flow increased by storage in Silver Lake (capacity, 1,900 acre-feet).

COOPERATION.—Complete records furnished by city engineer of Boulder.

Daily discharge, in second-feet, of North Boulder Creek at Silver Lake, Colo., for the period Aug. 20, 1913, to Sept. 30, 1917.

Day.	Aug.	Sept.	Day.	Aug.	Sept.	Day.	Aug.	Sept.
1913.			1913.			1913.		
1		28.8	11		34.4	21	25.2	15.7
2		26.1	12		35.8	22	24.9	15.5
3		31.0	13		35.0	23	24.6	15.4
4		39.8	14		32.4	24	24.9	15.1
5		56.2	15		26.2	25	25.3	14.7
6		62.8	16		25.8	26	24.9	13.6
7		57.8	17		25.8	27	24.3	12.7
8		56.8	18		25.7	28	23.9	12.4
9		52.9	19		21.6	29	23.6	12.2
10		39.8	20	25.5	17.0	30	23.4	12.2
						31	22.2	

Daily discharge, in second-feet, of North Boulder Creek at Silver Lake, Colo., for the period Aug. 21, 1913, to Sept. 30, 1914.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1913–14.												
1	12.2	8.19	6.30	4.91	3.43	3.01	6.20	3.40	95.4	76.2	89.7	29.8
2	12.1	8.38	6.30	4.91	3.51	3.01	3.30	3.30	173	74.4	84.3	29.3
3	12.0	8.29	3.49	4.31	3.30	3.01	3.10	3.06	192	73.9	78.1	28.2
4	12.1	8.38	3.61	3.70	3.21	3.01	3.10	2.96	145	73.9	72.1	27.2
5	10.5	8.29	3.75	3.70	3.21	3.10	3.10	2.96	118	79.6	66.6	26.0
6	11.3	7.89	4.00	3.70	3.10	3.10	3.10	3.06	104	79.2	60.9	24.9
7	11.9	7.69	4.20	3.70	3.10	3.10	3.20	3.20	89.0	81.2	51.5	24.3
8	12.0	7.59	4.20	3.70	3.21	3.10	3.20	3.30	76.0	79.0	50.5	20.8
9	11.8	7.48	4.40	3.70	3.40	3.01	3.20	3.57	70.5	78.0	48.7	20.8
10	11.0	7.38	4.62	3.40	3.70	3.01	3.20	3.84	70.5	80.5	46.3	20.9
11	3.40	7.29	4.70	3.40	3.70	3.10	3.10	4.11	75.8	86.0	31.8	20.9
12	9.58	7.29	4.80	3.30	3.80	3.10	3.10	4.40	98.8	88.6	33.4	21.1
13	9.68	7.29	4.61	3.30	3.70	3.10	3.01	4.70	108	88.4	43.0	21.6
14	9.68	7.29	4.31	3.40	3.80	3.10	3.01	5.00	122	87.4	43.0	16.0
15	9.49	7.20	4.31	3.40	3.80	3.10	3.01	5.26	128	85.8	43.0	7.20
16	9.19	6.98	4.26	3.30	3.80	3.20	3.01	6.40	116	85.0	41.3	7.10
17	8.89	6.90	4.21	3.21	3.80	3.20	3.01	10.2	112	93.1	39.3	17.0
18	8.79	6.81	4.11	3.21	3.80	3.20	3.10	13.6	111	83.4	37.2	22.0
19	8.79	6.81	4.00	3.20	3.80	3.20	3.10	17.0	126	80.0	35.3	21.9
20	8.79	6.81	3.96	3.30	3.80	3.30	4.40	39.0	130	76.0	34.4	17.8
21	8.79	6.69	3.90	3.40	3.80	3.30	4.40	38.5	130	75.7	34.1	16.8
22	8.59	6.64	3.90	3.40	3.80	3.30	4.40	39.2	114	83.4	33.9	13.0
23	8.59	6.60	3.88	3.70	3.80	3.30	4.40	50.0	103	84.9	33.6	15.6
24	8.59	6.60	3.80	3.30	3.80	3.30	5.20	50.9	98.5	80.6	32.2	15.8
25	8.68	6.49	3.75	3.30	3.80	3.30	3.40	50.8	93.5	76.2	30.5	16.2
26	8.68	6.49	3.70	3.40	3.80	3.30	3.40	50.1	85.7	69.6	29.8	11.1
27	8.50	6.49	4.40	3.40	3.80	3.30	3.40	53.4	79.5	65.2	29.4	9.80
28	8.29	6.49	5.00	3.40	3.20	3.30	3.40	73.0	76.3	57.7	26.5	9.80
29	8.19	6.49	5.04	3.40	......	3.30	3.40	67.4	75.7	57.3	26.1	9.80
30	8.19	6.49	5.04	3.51	......	3.30	3.40	64.0	76.8	78.1	25.5	9.19
31	8.19	......	4.96	3.51	......	3.30	......	63.7	......	93.1	26.1	......
1914–15.												
1	8.59	4.11	5.80	5.4	5.25	4.7	6.6	10.6	34.2	85.6	49.4	30.1
2	8.59	2.40	5.76	5.2	5.2	4.7	6.65	10.4	34.8	86.0	46.7	29.1
3	5.15	5.41	5.71	5.1	5.2	4.7	6.7	10.2	14.1	87.6	44.4	28.2
4	2.01	6.21	5.71	5.05	5.2	4.7	6.8	10.4	8.8	81.8	42.9	28.8
5	6.30	6.10	5.65	5.0	5.2	6.2	6.9	10.6	9.8	80.1	41.6	29.6
6	6.90	5.60	5.60	5.0	5.55	6.3	6.9	9.9	10.8	82.2	41.0	29.4
7	6.90	5.50	5.60	5.0	6.05	6.35	6.9	9.3	12.0	80.8	41.9	26.3
8	8.89	5.50	5.60	5.0	6.25	6.4	6.85	13.9	12.5	79.2	44.6	20.1
9	8.45	5.50	5.60	5.1	6.35	6.6	6.8	14.3	24.6	75.2	47.9	11.8
10	6.99	4.91	5.60	5.2	6.4	7.0	6.8	13.7	36.9	75.5	50.2	13.9
11	6.80	4.91	5.60	5.2	6.45	7.3	10.5	13.4	55.8	81.7	48.5	17.4
12	6.80	4.91	5.60	5.15	6.5	7.6	10.1	14.4	67.6	88.8	46.6	21.6
13	6.99	5.00	5.65	5.1	4.8	7.0	10.8	16.3	59.4	93.8	44.6	26.1
14	6.99	5.11	5.71	5.1	4.95	7.0	10.6	18.2	55.2	94.7	44.6	24.0
15	6.99	5.20	5.71	5.1	5.0	7.05	10.5	26.8	51.1	93.2	45.6	23.7
16	6.99	5.20	5.71	5.1	5.0	7.15	10.2	25.0	45.2	89.4	44.6	22.7
17	6.99	5.20	5.71	5.15	5.0	7.5	10.0	24.3	48.8	84.2	42.6	22.1
18	6.00	5.11	5.71	5.2	5.0	7.1	9.8	22.0	52.5	78.3	40.8	22.4
19	4.71	5.20	5.76	5.2	5.0	7.1	9.7	18.0	58.7	61.1	39.8	20.3
20	4.71	5.30	6.40	5.15	4.85	7.2	9.4	14.5	67.7	65.8	38.6	24.4
21	4.71	5.56	5.50	5.1	4.7	7.3	9.2	11.7	89.8	63.5	35.6	25.6
22	4.96	5.71	5.56	5.15	4.65	7.05	9.2	10.6	107	60.7	33.1	25.1
23	5.15	5.80	5.60	5.2	4.65	7.1	9.2	11.3	128	53.0	32.2	31.2
24	5.30	5.90	5.41	5.2	4.7	7.0	9.2	14.4	131	55.9	31.5	34.4
25	5.41	5.90	5.20	5.2	4.7	6.8	8.7	17.6	125	55.9	30.3	36.0
26	5.44	5.90	5.20	5.2	4.7	6.8	8.4	18.2	109	55.9	29.0	34.4
27	5.56	5.85	5.20	5.2	4.7	6.8	8.45	17.5	100	55.9	30.0	36.0
28	5.74	5.80	5.20	5.25	4.7	6.8	8.7	16.9	92.4	53.1	36.0	36.0
29	6.00	5.80	5.26	5.3	......	6.8	9.6	13.4	88.4	51.5	34.7	36.0
30	6.10	5.80	5.30	5.3	......	6.8	10.4	23.7	86.8	51.4	33.2	32.2
31	5.56	......	5.41	5.3	......	6.6	......	28.9	......	50.3	31.8	......

Daily discharge, in second-feet, of North Boulder Creek at Silver Lake, Colo., for the period Aug. 20, 1913, to Sept. 30, 1917—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915-16.												
1	28.2	8.8	5.8	4.8	6.5	5.3	2.2	4.3	19.6	53.5	46.8	16.8
2	25.1	5.0	5.8	4.7	7.5	5.3	2.2	4.3	19.0	47.6	45.4	15.8
3	22.3	5.3	5.9	4.6	7.4	5.3	2.3	4.3	18.6	49.2	41.5	14.8
4	15.7	5.3	5.7	4.6	7.2	5.3	2.5	4.3	20.0	49.0	39.0	14.6
5	15.4	5.2	5.0	4.9	7.1	5.25	3.8	4.3	21.0	47.0	37.5	17.7
6	15.4	7.73	5.0	4.9	5.4	5.0	3.7	4.3	19.1	47.0	36.8	18.2
7	15.3	9.5	5.0	4.8	6.15	3.1	3.6	3.7	18.4	47.4	36.8	16.7
8	15.1	7.8	5.0	4.7	5.71	3.8	3.4	3.25	19.8	46.2	36.8	16.2
9	12.7	7.5	5.0	4.8	5.2	4.0	3.25	3.1	22.1	47.4	37.0	16.6
10	8.9	7.1	4.8	4.9	4.45	4.0	3.25	1.8	23.2	51.0	36.7	18.0
11	8.9	6.8	4.9	5.0	4.3	3.85	4.0	1.2	23.2	54.4	36.0	18.7
12	8.9	6.5	4.7	5.0	5.15	3.75	3.8	8.4	24.8	52.4	35.0	18.3
13	9.4	9.1	4.7	4.9	6.45	3.6	4.0	18.6	30.0	46.4	34.0	18.8
14	11.2	6.2	4.7	4.9	5.21	3.6	4.0	12.2	35.9	43.2	33.4	16.0
15	9.8	6.2	4.7	4.1	4.8	3.55	4.0	11.7	40.0	41.8	33.0	14.0
16	9.9	6.1	4.8	6.7	5.2	3.45	3.8	9.8	43.6	41.0	32.5	12.8
17	10.0	6.1	4.9	9.3	5.1	3.3	3.8	7.2	47.2	41.0	32.3	11.8
18	9.9	6.1	4.6	7.3	5.0	3.2	3.8	7.2	50.0	40.8	31.2	11.0
19	9.8	5.8	4.6	6.3	4.8	3.0	3.7	7.6	51.6	39.7	29.2	10.2
20	9.7	6.2	4.6	5.8	4.65	2.9	3.7	8.8	53.2	39.5	28.0	9.95
21	9.6	6.7	4.7	5.8	4.6	3.05	3.6	9.4	54.6	39.0	26.5	9.35
22	9.6	6.2	4.6	5.4	4.6	3.05	3.6	8.8	52.6	37.5	24.7	8.55
23	9.2	5.8	5.2	5.4	4.6	2.9	3.6	8.2	49.2	35.8	23.6	8.50
24	6.5	5.7	5.5	5.3	4.55	2.8	3.6	7.8	46.4	34.9	22.1	8.8
25	5.2	5.7	3.9	5.3	4.5	2.8	3.7	8.8	45.0	34.6	21.0	8.9
26	6.8	5.8	4.8	5.3	4.5	2.4	3.7	11.5	46.4	34.4	21.0	8.4
27	5	6	5.0	5.2	4.5	1.85	3.8	12.8	49.0	35.2	20.6	7.6
28	5	6	5.6	5.0	4.55	1.7	4.0	13.4	52.0	35.4	19.6	6.85
29	5	5.9	4.6	5.0	5.0	1.75	4.0	13.9	55.4	36.3	18.6	6.55
30	5	5.8	4.6	5.6	......	2.0	4.2	16.0	57.2	40.1	18.0	7.6
31	6	......	4.6	6.5	......	2.25	......	16.6	......	44.2	17.4	......
1916-17.												
1	5.55	8.70	5.65	5.2	6.6	7.8	1.8	1.9	2.0	101	99.4	24.2
2	5.75	8.60	5.2	5.2	6.6	7.7	1.8	1.8	1.3	105	87.5	23.4
3	6.05	5.05	4.0	4.8	6.5	7.7	1.8	1.8	3.0	100	76.2	23.4
4	6.45	6.05	4.0	4.8	6.3	7.4	1.8	1.8	9.0	91.0	43.0	23.2
5	9.3	6.80	4.3	4.7	6.2	7.3	1.8	1.7	11.3	81.4	48.0	23.2
6	12.9	7.20	4.3	4.7	6.2	7.3	1.7	1.7	15.0	79.4	50.0	26.2
7	7.15	7.40	4.3	4.7	6.2	7.1	1.7	1.8	18.0	78.8	50.8	26.2
8	7.0	7.90	4.0	4.8	4.6	7.1	1.7	1.8	21.2	65.0	48.0	25.2
9	8.2	8.15	3.7	4.8	4.6	7.1	1.7	1.9	26.0	91.6	48.0	25.2
10	8.2	7.85	5.8	4.8	6.0	7.1	1.6	1.9	36.3	90.8	50.8	23.4
11	8.2	7.40	4.95	4.9	6.3	7.1	1.6	1.9	27.0	91.6	51.6	23.4
12	8.2	7.20	4.7	5.0	6.2	7.0	1.6	2.2	29.8	96.4	56.6	23.4
13	8.25	7.30	4.7	5.0	6.5	7.1	1.6	2.2	24.4	96.0	55.4	23.4
14	6.2	7.25	4.7	5.7	6.7	7.1	1.6	2.3	38.0	96.0	53.8	23.4
15	3.8	7.00	6.3	6.3	7.0	7.1	1.6	2.7	40.2	84.4	53.8	18.6
16	3.7	6.90	6.4	6.7	7.4	7.1	1.5	3.4	42.8	80.6	38.7	19.0
17	2.2	6.85	5.55	6.8	7.0	7.1	1.5	8.0	44.5	75.0	38.7	19.0
18	1.3	6.80	4.7	6.9	6.9	6.3	1.5	15.0	44.5	68.6	40.7	19.0
19	2.8	6.80	6.4	7.6	7.3	6.2	1.5	60.0	44.5	66.8	34.5	12.5
20	3.3	6.80	6.1	7.8	7.3	6.2	1.5	33.0	44.4	58.8	33.2	12.5
21	4.2	6.85	5.8	7.9	7.2	6.3	1.5	16.6	48.0	58.8	33.2	12.4
22	3.9	6.90	5.8	8.3	7.2	5.8	1.5	12.8	51.6	55.0	31.7	12.4
23	3.15	6.70	5.8	8.3	7.2	5.5	1.5	9.6	55.5	51.6	31.2	12.4
24	3.85	6.40	5.8	8.0	7.2	5.4	1.5	4.0	70.5	52.6	31.2	12.4
25	9.0	6.30	5.8	8.1	7.2	5.0	1.6	2.3	105	54.0	30.0	12.4
26	11.8	6.30	5.7	8.2	7.2	4.6	1.7	1.5	105	55.2	26.2	12.4
27	11.0	6.25	5.5	8.1	7.7	3.8	1.7	2.0	98.8	56.5	26.2	12.4
28	10.4	6.00	5.5	7.2	7.8	1.8	1.7	2.0	98.2	58.2	24.2	12.4
29	9.75	5.90	5.5	7.2	......	1.8	1.7	2.0	97.6	77.4	24.2	12.4
30	9.2	5.90	5.5	7.0	......	1.8	2.5	2.0	97.6	83.0	24.2	12.4
31	8.9	......	5.5	6.9	......	1.8	......	2.0	......	101	24.2	......

Monthly discharge of North Boulder Creek at Silver Lake, Colo., for the period Aug. 20, 1913, to Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1913.				
August 20-31	25.5	22.2	24.4	581
September	62.8	12.2	28.9	1,720
1913-14.				
October	12.2	3.40	9.56	588
November	8.38	6.49	7.19	428
December	6.30	3.49	4.37	269
January	4.91	3.20	3.56	219
February	3.80	3.10	3.60	200
March	3.30	3.01	3.17	195
April	6.20	3.01	3.51	209
May	73.0	2.96	24.0	1,480
June	192	70.5	106	6,310
July	93.1	57.3	78.9	4,850
August	89.7	25.1	43.8	2,690
September	29.8	7.10	18.4	1,090
The year	192	2.96	25.5	18,500
1914-15.				
October	8.89	2.01	6.22	382
November	6.21	2.40	5.35	318
December	6.40	5.20	5.58	343
January	5.4	5.0	5.16	317
February	6.5	4.65	5.24	291
March	7.6	4.7	6.63	408
April	10.8	6.6	8.68	516
May	28.9	9.3	15.8	972
June	131	8.8	60.6	3,610
July	94.7	50.3	72.6	4,460
August	50.2	29.0	40.1	2,470
September	36.0	11.8	26.9	1,600
The year	131	2.01	21.6	15,700
1915-16.				
October	28.2	5.0	11.1	682
November	9.5	5.0	6.46	384
December	5.9	3.9	4.95	304
January	9.3	4.1	5.38	331
February	7.4	4.3	5.33	307
March	5.3	1.7	3.45	212
April	4.2	2.2	3.55	211
May	18.6	1.2	8.31	511
June	57.2	18.4	36.9	2,200
July	54.4	34.4	43.0	2,640
August	46.8	17.4	30.7	1,890
September	18.8	6.56	12.9	768
The year	57.2	1.2	14.3	10,400
1916-17.				
October	12.9	1.3	6.76	416
November	8.7	5.05	6.92	412
December	6.4	3.7	5.22	321
January	8.3	4.7	6.33	389
February	7.8	4.6	6.68	371
March	7.8	1.8	5.98	368
April	2.5	1.5	1.66	99
May	60.0	1.5	6.65	409
June	105	1.3	38.7	2,300
July	105	51.6	77.5	4,770
August	99.4	24.2	44.1	2,710
September	26.2	12.4	18.7	1,110
The year	105	1.3	18.9	13,700

SOUTH BOULDER CREEK NEAR ROLLINSVILLE, COLO.

LOCATION.—In sec. 35, T. 1 S., R. 73 W., 1 mile west of Rollinsville, Gilpin County. Nearest important tributary, Jenny Creek, enters 3 miles above.

DRAINAGE AREA.—39 square miles (measured on topographic maps).

RECORDS AVAILABLE.—September 10, 1910, to September 30, 1917.

GAGE.—Vertical staff spiked to tree on left bank, 500 feet above bridge, used since June 2, 1916; vertical staff on downstream side of right abutment used May 8 to June 1, 1916; vertical staff on upstream side of right abutment used prior to May 8, 1916; read by Miss Grace Grant.

DISCHARGE MEASUREMENTS.—Made from two-span bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of coarse gravel and small boulders. Control not well defined; shifts occasionally. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.38 feet at 5 p. m. June 22 (discharge, 432 second-feet); minimum discharge occurs during winter.

ICE.—Stage-discharge relation affected by ice for short periods.

DIVERSIONS.—No court decrees for diversion above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation slightly shifting; affected by ice during winter. Rating curve used October 1 to December 31 well defined between 15 and 300 second-feet; curve used April 15 to September 30 well defiend between 10 and 350 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of South Boulder Creek near Rollinsville, Colo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 29	J. H. Keep	a 0.92	11.9	June 30	Robert Follansbee	1.98	275
Feb. 21	do	a 1.10	7.5	Aug. 17	S. B. Soulé	1.22	37.9

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of South Boulder Creek near Rollinsville, Colo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	17	19	14		31	105	300	90	22
2	17	19	13		31	102	260	72	22
3	17	19	13		28	109	240	63	22
4	17	19	14		22	170	240	63	17
5	17	18	14		23	170	222	44	13
6	17	17	14		25	166	222	44	13
7	17	17	14		23	170	205	41	13
8	17	15	14		23	170	205	36	13
9	17	15	14		23	300	222	32	14
10	17	16	14		23	320	222	31	14
11	17	16	14		32	300	222	34	14
12	17	14	14		41	320	188	32	14
13	17	13	14		61	320	156	32	14
14	17	14	13		122	320	156	32	14
15	15	15	14	16	170	360	135	36	14
16	20	16	14	17	222	360	122	36	14
17	25	17	14	17	260	400	115	41	14
18	21	17	14	23	280	360	115	32	13
19	20	17	14	17	222	340	115	31	13
20	21	17	14	20	188	360	115	31	13
21	19	17	14	23	138	360	122	31	10
22	23	15	14	32	115	400	115	28	10
23	21	15	14	34	115	400	102	27	10
24	21	14	14	41	115	380	118	27	10
25	21	14	14	34	118	340	115	22	10
26	21	14	14	37	115	320	212	22	13
27	21	14	14	32	102	300	205	22	10
28	21	14	14	31	102	300	115	22	10
29	21	14	12	31	105	300	128	23	8
30	20	13	12	31	105	300	118	23	6
31	20		12		105		102	22	

NOTE.—Stage-discharge relation affected by ice Nov. 8-16, Dec. 29-31; discharge based on temperature and gage-height record, discharge measurements, and observer's notes.

Monthly discharge of South Boulder Creek near Rollinsville, Colo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	25	15	19.0	1,170
November	19	13	15.8	940
December	14	12	13.7	842
April 15–30	41	16	27.2	863
May	280	22	99.2	6,100
June	400	102	287	17,100
July	300	102	169	10,400
August	90	22	36.2	2,230
September	22	6	13.2	785

BIG THOMPSON CREEK NEAR DRAKE, COLO.

LOCATION.—In sec. 2, T. 5 N., R. 71 W., at highway bridge No. 7 in Big Thompson Canyon, 200 yards below Loveland dam and 1½ miles east of Drake, in Larimer County. Nearest tributary, North Fork, enters at Drake.

DRAINAGE AREA.—274 square miles (measured on topographic map).

RECORDS.—September 18–30, 1917.

GAGE.—Bristol pressure gage attached to left bridge abutment.

DISCHARGE MEASUREMENTS.—Made from single-span bridge.

CHANNEL AND CONTROL.—Channel is pool in which several feet of silt are deposited and scoured out; control 50 feet downstream at rapids of compact gravel; practically permanent during 1917. Banks not subject to overflow.

ICE.—Stage-discharge relation seriously affected by ice. Winter measurements made at section half a mile upstream.

DIVERSIONS.—Court decrees for diversion of 23 second-feet from river above station and 2,277 second-feet below, also decrees for storage of 81,000 acre-feet below station.

REGULATION.—Alternate melting and freezing of mountain snows during spring causes diurnal fluctuation. No artificial regulation.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice during winter. Rating curve well defined between 25 and 650 second-feet. Water-stage recorder gave satisfactory results. Daily discharge ascertained by applying to the rating table mean daily gage height determined by inspecting gage-height graph. Records good.

COOPERATION.—Field data furnished by city of Loveland. Discharge measurement also made by United States Geological Survey.

Discharge measurements of Big Thompson Creek near Drake, Colo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Inches.	*Sec.-ft.*			*Inches.*	*Sec.-ft.*
Feb. 20	Hodges and Bice		23.8	Apr. 21	E. S. Bice	17	69
26	E. S. Bice		25.5	July 24	.....do	35	629
Mar. 9	.....do		22.4	Aug. 18	.....do	25	230
23	.....do		26.1	30	.....do	21.5	175

Daily discharge, in second-feet, of Big Thompson Creek near Drake, Colo., for the period Sept. 18–30, 1917.

Sept. 18	106	Sept. 23	80	Sept. 27	76
19	98	24	80	28	72
20	93	25	89	29	61
21	89	26	80	30	61
22	85				

KANSAS RIVER BASIN.

REPUBLICAN RIVER AT WAKEFIELD, KANS.

LOCATION.—In NE. ¼ sec. 5, T. 10 S., R. 4 E., at highway bridge 1,000 feet north of Union Pacific Railroad station at Wakefield, Clay County.

DRAINAGE AREA.—Not determined.

RECORDS AVAILABLE.—June 21 to September 30, 1917.

GAGE.—Chain gage bolted to upstream guard timber of highway bridge in center of middle span.

DISCHARGE MEASUREMENTS.—Made from downstream side of highway bridge or by wading.

CHANNEL AND CONTROL.—Bed is sandy and shifting. The river is confined within fairly high banks that are fairly clean of vegetation. At high water the river overflows on left bank and spreads out over entire valley floor a distance of from 2 to 3 miles in width. The right bank is high and is not overflowed at the gage.

EXTREMES OF STAGE.—Maximum stage recorded during the period, 3.4 feet on June 21, 1917; minimum stage, 1.65 feet on September 12 and 17, 1917.

During the flood of June, 1915, the river rose to within a few feet of the bridge floor, which is approximately gage height, 22½ feet, and flooded out the entire valley. Flood stage occurs at 12 feet gage height.

ICE.—Stage-discharge relation affected by ice.

REGULATION.—Flow is affected by regulation by a dam at Clay Center.

ACCURACY.—Gage heights are means of two daily readings.

Data inadequate for determination of discharge.

Discharge measurements of Republican River at Wakefield, Kans., during the year ending Sept. 30, 1917.

[Made by R. C. Rice.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 21	3.38	750
July 26	2.04	84
Sept. 5	1.78	55

Daily gage height, in feet, of Republican River at Wakefield, Kans., for the year ending Sept. 30, 1917.

[S. R. Winsor, observer.]

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1		3.0	2.0	2.1	16		2.45	2.4	1.75
2		2.9	1.95	2.15	17		2.5	2.2	1.65
3		2.9	1.9	1.85	18		2.45	2.1	1.85
4		2.85	1.8	1.95	19		2.4	2.05	1.75
5		2.85	2.35	1.9	20		2.4	2.35	1.95
6		2.75	2.15	1.95	21	3.4	2.35	2.2	2.65
7		2.8	2.85	1.95	22	3.3	2.3	2.25	2.5
8		2.7	3.05	1.95	23	3.3	2.3	2.3	2.4
9		2.7	2.8	2.0	24	3.25	2.25	2.3	2.6
10		2.65	3.05	1.7	25	3.2	2.3	2.15	2.65
11		2.6	3.5	1.85	26	3.1	2.3	2.2	2.65
12		2.5	2.7	1.65	27	3.1	2.2	2.2	2.7
13		2.55	2.55	1.8	28	3.05	2.3	2.15	2.75
14		2.5	2.4	1.85	29	3.05	2.35	2.15	4.0
15		2.4	2.45	1.8	30	3.1	1.9	2.05	3.6
					31		2.05	2.0	

KANSAS RIVER AT OGDEN, KANS.

Location.—In SE. ¼ sec. 12, T. 11 S., R. 6 E., at highway bridge three-fourths of a mile southeast of Ogden, Riley County, Kans. Sevenmile Creek enters from north a quarter of a mile upstream; Clark Creek enters from south 2 miles upstream. Smoky Hill and Republican rivers unite near Junction City, 6 miles by direct line (10 miles by river) upstream, to form Kansas River. Camp Funston is at Ogden Flats, along Kansas River 1½ miles upstream.

Drainage area.—Not determined.

Records available.—June 19 to September 30, 1917.

Gage.—Chain gage bolted to upstream landrail of highway bridge in center of span next to right bank; read by Arthur Estes.

Discharge measurements.—Made from downstream side of bridge or by wading.

Channel and control.—Bed composed of sand; control shifting. Stone jetty on right bank about 50 feet downstream from bridge partially controls flow at low water. There are old bridge members in channel below bridge, which are the remains of an old bridge that was washed out.

Extremes of stage.—Maximum stage recorded during period, 9.7 feet on August 17, 1917; minimum stage, 3.8 feet on August 2, 1917. Flood stage occurs at about 21 feet.

Ice.—Discharge affected by ice.

Regulation.—Flow affected somewhat by mill and power regulation on the tributaries of Kansas River.

Accuracy.—Gage heights are means of two daily readings.

Data inadequate for determination of discharge.

Discharge measurements of Kansas River at Ogden, Kans., during the year ending Sept. 30, 1917.

[Made by R. C. Rice.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 19	6.34	1,680
July 25	4.23	354
Sept. 3	5.13	769

Daily gage height, in feet, of Kansas River at Ogden, Kans., for the year ending Sept. 30, 1917.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1		5.45	4.0	5.45	16		4.7	9.15	4.4
2		5.4	3.8	5.3	17		4.5	9.7	4.5
3		5.4	4.0	5.2	18		4.5	9.2	4.45
4		5.0	4.1	5.15	19	6.35	4.75	8.85	4.55
5		5.15	4.05	5.2	20	6.3	4.6	9.0	4.45
6		5.15	4.1	5.15	21	6.15	4.45	8.6	4.3
7		5.0	5.1	4.7	22	6.6	4.4	7.7	4.7
8		5.1	5.3	4.55	23	5.95	4.4	7.0	4.75
9		4.95	6.05	4.8	24	5.9	4.35	7.05	4.95
10		5.1	5.9	4.9	25	5.7	4.45	6.5	4.85
11		4.9	6.05	4.55	26	5.65	4.4	6.1	5.7
12		4.9	7.15	4.75	27	5.6	4.35	6.5	5.35
13		4.8	6.6	4.65	28	5.6	4.35	6.5	5.15
14		4.6	5.95	4.55	29	5.55	4.2	6.1	5.1
15		4.65	6.9	4.5	30	5.35	3.9	5.8	5.95
					31		4.05	5.65	

KANSAS RIVER AT TOPEKA, KANS.

Location.—At Chicago, Rock Island & Pacific Railroad bridge 2,100 feet upstream from Melan arch highway bridge, at Topeka, Shawnee County. Soldier Creek enters about 1½ miles downstream.

Drainage area.—Not determined.

Records available.—April 24 to August 31, 1904, and June 12 to September 30, 1917.

Gage.—Chain gage bolted to floor beam of second span of railroad bridge, 235 feet out from right abutment on the downstream side; read by T. H. Beeson. Gage set to read the same as the United States Weather Bureau chain gage on Melan arch bridge on June 12, 1917, when the stage there read 9.1 feet, at 1.40 p. m. In 1904 a station was maintained at this point for flood observations. A staff gage was painted on one of the piers of the railroad bridge at an arbitrary datum.

Discharge measurements.—Made from downstream side of railroad bridge.

Channel and control.—Bed composed of sand and silt; the Melan arch bridge and old bridge piles and riprapping under and upstream from it act as an artificial control for the stage-discharge relation. Banks are levied upstream and downstream so that the stream is confined for all stages.

Extremes of discharge.—Maximum stage recorded during period, 9.4 feet on June 12, 1917 (discharge, 12,400 second-feet); minimum stage, 4.3 feet on August 4 and 5, 1917 (discharge, 1,010 second-feet).

Ice.—Discharge affected by ice. Flow from outfall sewers entering Kansas River 500 feet upstream from the Melan arch bridge usually keeps the main channel open at that point.

Regulation.—None, except slight effect of power regulation on tributaries upstream.

Accuracy.—Stage-discharge relation not permanent. Rating curves used June 12 to September 9 and September 10–30 fairly well defined. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Kansas River at Topeka, Kans., during the year ending Sept. 30, 1917.

[Made by R. C. Rice.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 13	9.53	12,900
28	6.07	3,050
Aug. 17	7.21	5,390

Daily gage height, in feet, of Kansas River at Topeka, Kans., for the year ending Sept. 30, 1917.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1		5.8	4.45	5.35	16	7.5	5.05	6.85	5.0
2		5.8	4.5	5.3	17	7.2	5.0	7.2	4.95
3		5.9	4.4	5.15	18	7.0	5.0	8.35	4.8
4		5.8	4.3	5.0	19	6.8	4.9	6.9	4.8
5		5.75	4.3	4.85	20	6.65	4.85	7.65	4.8
6		5.6	4.35	4.75	21	6.5	4.9	7.65	4.6
7		5.6	4.4	4.8	22	6.4	4.8	7.75	4.55
8		5.55	5.8	4.8	23	6.3	4.8	7.2	4.7
9		5.5	6.15	4.8	24	6.2	4.7	6.5	4.9
10		5.3	5.9	7.45	25	6.1	4.95	6.4	4.8
11		5.3	6.2	6.55	26	6.1	5.0	6.4	5.25
12	9.4	5.3	6.45	6.1	27	6.0	4.85	6.1	5.2
13	9.4	5.25	6.7	5.65	28	6.0	4.7	5.9	5.35
14	8.75	5.15	7.0	5.35	29	5.9	4.5	5.9	4.95
15	7.75	5.1	8.0	5.1	30	5.85	4.45	5.8	4.85
					31		4.55	5.5	

Daily discharge, in second-feet, of Kansas River at Topeka, Kans., for the year ending Sept. 30, 1917.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1		2,710	1,130	2,110	16	6,240	1,750	4,620	2,100
2		2,710	1,170	2,050	17	5,430	1,690	5,430	2,040
3		2,850	1,090	1,870	18	4,950	1,690	8,860	1,860
4		2,710	1,010	1,690	19	4,510	1,590	4,730	1,960
5		2,640	1,010	1,520	20	4,190	1,520	6,670	1,860
6		2,430	1,050	1,420	21	3,890	1,580	6,670	1,640
7		2,430	1,090	1,470	22	3,710	1,470	6,970	1,590
8		2,360	2,710	1,470	23	3,530	1,470	5,430	1,750
9		2,300	3,260	1,470	24	3,350	1,360	3,890	1,980
10		2,050	2,850	6,390	25	3,170	1,640	3,710	1,860
11		2,050	3,350	4,410	26	3,170	1,690	3,710	2,420
12	12,400	2,050	3,800	3,660	27	3,010	1,520	3,170	2,350
13	12,400	1,990	4,290	2,980	28	3,010	1,360	2,850	2,550
14	10,200	1,870	4,950	2,550	29	2,850	1,170	2,850	2,040
15	6,970	1,810	7,740	2,220	30	2,780	1,130	2,710	1,920
					31		1,220	2,300	

Monthly discharge of Kansas River at Topeka, Kans., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
June 12-30	12,400	2,780	5,250	198,000
July	2,850	1,130	1,900	117,000
August	8,860	1,010	3,710	228,000
September	6,390	1,470	2,240	133,000

KANSAS RIVER AT BONNER SPRINGS, KANS.

Location.—In NW. ¼ sec. 32, T. 11 S., R. 23 E., at highway bridge at Bonner Springs, Wyandotte County. Wolf Creek enters from north just above Atchison, Topeka & Santa Fe Railway bridge, half a mile upstream. Station is 18 miles by river above Kansas City, Mo., and above backwater influence of Missouri River.

Drainage area.—Not determined.

Records available.—July 8 to September 30, 1917.

Gage.—Chain gage bolted to upstream landrail of highway bridge in center of second span from left bank; read by M. E. Kenton.

Discharge measurement.—Made from downstream side of highway bridge.

Channel and control.—Bed composed of sand and gravel; control shifts at high water. Right bank subject to overflow at high stages; left bank high and fairly steep.

Extremes of stage.—Maximum stage recorded during the period, 7.0 feet on August 16, 1917; minimum stage, 3.95 feet on September 23 and 24, 1917.

Ice.—Stage-discharge relation affected by ice.

Regulation.—Flow affected somewhat by mill operation at Lawrence.

Accuracy.—Gage heights are means of two daily readings.

Data inadequate for determination of discharge.

The following measurement was made by R. C. Rice:

July 8, 1917: Gage height, 4.90 feet; discharge, 2,480 second-feet.

Daily gage height, in feet, of Kansas River at Bonner Springs, Kans., for the year ending Sept. 30, 1917.

Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.
1		4.15	4.75	11	4.75	5.55	5.8	21	4.35	6.6	4.1
2		4.05	4.6	12	4.65	5.4	5.7	22	4.3	6.5	4.0
3		4.0	4.5	13	4.65	5.5	5.2	23	4.3	6.55	3.95
4		4.0	4.45	14	4.6	6.35	5.0	24	4.3	6.1	3.95
5		4.05	4.3	15	4.6	6.7	4.7	25	4.3	5.6	4.15
6		4.0	4.2	16	4.5	7.0	4.5	26	4.3	5.45	5.25
7		4.05	4.15	17	4.5	6.05	4.35	27	4.4	5.45	5.5
8	4.9	4.1	4.15	18	4.45	6.2	4.3	28	4.4	5.1	5.0
9	4.9	5.0	4.7	19	4.3	6.95	4.15	29	4.3	4.9	4.7
10	4.85	5.75	5.0	20	4.35	6.6	4.1	30	4.2	4.9	4.5
								31	4.2	4.9	

MISCELLANEOUS MEASUREMENTS.

Measurements of the flow of streams in the Missouri River basin at points other than gaging stations are recorded in the following table:

Miscellaneous measurements in Missouri River drainage basin during the year ending Sept. 30, 1917.

Date.	Stream.	Tributary to, or diverts from—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
May 9	Big Hole River	Jefferson River	Divide, Mont	4.54	2,880
Aug. 25	City ditch (Helena, Mont.).	Tenmile Creek	Moose Creek ranger station, Mont.	4.22	3.2
13	Birch Creek	Two Medicine River.	Fischer's ranch, near Valier, Mont.		64
June 22	Eldorado ditch	Left bank of Teton River.[a]	Crossing of highway between Strabane and Chouteau, Mont.		83
22	Monkman ditch	do	do		1.2
22	Farmer's ditch	do	do		119
22	Cashman ditch	do	do		7.0
22	Burton ditch	do	do		66
Oct. 24	Dogtooth Creek	Cannonball River.	Sec. 4, T. 134 N., R. 82 W., at Timmer, N. Dak., one-fourth mile below mouth of Louise Creek.		2.5
May 23	do	do	do		14.0
July 26	do	do	do		[b] 1.8
Aug. 27	do	do	do		[b] .9
Oct. 23	Oak Creek	Missouri River	Sec. 27, T. 20 N., R. 29 E., at Wakpala, S. Dak.		5.9
June 19	do	do	do		[b] 1.0
July 24	do	do	do		[b] .2
Aug. 20	do	do	do		.0
24	Little Missouri River	do	Highway bridge at Marmarth, S. Dak.	[c] 24.40	11.8
May 15	Greybull River	Big Horn River	Meeteetse, Wyo	3.20	2,350
June 24	do	do	do	3.12	3,080
July 19	Clear Creek	Powder River	Above Piney Creek at Ucross, Wyo.		75
18	do	do	Clearmont, Wyo	2.0	64
24	do	do	do		91
June 15	Camp Creek	North Platte River.	Mouth, sec. 11, T. 11 N., R. 80 W., Colo.		[b] 50
15	Threemile Creek	do	Mouth, sec. 25, T. 12 N., R. 80 W., Colo.		[b] 5
Oct. 24	Cedar Creek	do	Sec. 28, T. 17 N., R. 83 W., Wyo.		2.4
24	South Spring	do	Sec. 31, T. 16 N., R. 84 W., Wyo.		16
11	North Platte River	Platte River	Pathfinder, Wyo	3.10	1,180
30	Bear Creek	South Platte River	Morrison, Colo		28

[a] Canals divert from Teton River and head on north bank between Strabane and Chouteau; canals listed in downstream order, beginning at Strabane.
[b] Estimated.
[c] Distance from reference point to water surface.

INDEX.

STREAM-GAGING STATIONS

AND

PUBLICATIONS RELATING TO WATER RESOURCES

PART VI. MISSOURI RIVER BASIN

STREAM-GAGING STATIONS AND PUBLICATIONS RELATING TO WATER RESOURCES.

INTRODUCTION.

Investigation of water resources by the United States Geological Survey has consisted in large part of measurements of the volume of flow of streams and studies of the conditions affecting that flow, but it has comprised also investigation of such closely allied subjects as irrigation, water storage, water powers, underground waters, and quality of waters. Most of the results of these investigations have been published in the series of water-supply papers, but some have appeared in the monographs, bulletins, professional papers, and annual reports.

The results of stream-flow measurements are now published annually in 12 parts, each part covering an area whose boundaries coincide with natural drainage features as indicated below:

Part I. North Atlantic basins.
II. South Atlantic and eastern Gulf of Mexico basins.
III. Ohio River basin.
IV. St. Lawrence River basin.
V. Upper Mississippi River and Hudson Bay basins.
VI. Missouri River basin.
VII. Lower Mississippi River basin.
VIII. Western Gulf of Mexico basins.
IX. Colorado River basin.
X. Great basin.
XI. Pacific basins in California.
XII. North Pacific slope basins, in three volumes:
A, Pacific slope basins in Washington and upper Columbia River basin.
B, Snake River basin.
C, Lower Columbia River basin and Pacific slope basins in Oregon.

HOW GOVERNMENT REPORTS MAY BE OBTAINED OR CONSULTED.

Water-supply papers and other publications of the United States Geological Survey containing data in regard to the water resources of the United States may be obtained or consulted as indicated below:

1. Copies may be obtained free of charge by applying to the Director of the Geological Survey, Washington, D. C. The edition printed for free distribution is, however, small and is soon exhausted.

2. Copies may be purchased at nominal cost from the Superintendent of Documents, Government Printing Office, Washington, D. C., who will on application furnish lists, giving prices.

3. Sets of the reports may be consulted in the libraries of the principal cities of the United States.

4. Complete sets are available for consultation in the local office of the water-resources branch of the Geological Survey, as follows:

Boston, Mass., 2500 Customhouse.
Albany, N. Y., Room 704 Journal Building.
Harrisburg, Pa., Care of Water Supply Commission.
Asheville, N. C., 32-35 Broadway.
Chattanooga, Tenn., Temple Court Building.
Madison, Wis., care of Railroad Commission of Wisconsin.
Chicago, Ill., 1404 Kimball Building.
Ames, Iowa, care of State Highway Commission.
Topeka, Kans., 23 Federal Building.
Helena, Mont., Montana National Bank Building.
Denver, Colo., 403 New Post Office Building.
Salt Lake City, Utah, 421 Federal Building.
Boise, Idaho, 615 Idaho Building.
Idaho Falls, Idaho, 228 Federal Building.
Tacoma, Wash., 406 Federal Building.
Portland, Oreg., 606 Post Office Building.
San Francisco, Calif., 328 Customhouse.
Los Angeles, Calif., 619 Federal Building.
Austin, Tex., Capitol Building.
Honolulu, Hawaii, 14 Capitol Building.

A list of the Geological Survey's publications may be obtained by applying to the Director, United States Geological Survey, Washington, D. C.

STREAM-FLOW REPORTS.

Stream-flow records have been obtained at more than 4,240 points in the United States, and the data obtained have been published in the reports tabulated below:

Stream-flow data in reports of the United States Geological Survey.

[A=Annual Report; B=Bulletin; W=Water-Supply Paper.]

Report.	Character of data.	Year.
10th A, pt. 2	Descriptive information only	
11th A, pt. 2	Monthly discharge and descriptive information	1884 to Sept., 1890.
12th A, pt. 2	....do	1884 to June 30, 1891.
13th A, pt. 3	Mean discharge in second-feet	1884 to Dec. 31, 1892.
14th A, pt. 2	Monthly discharge (long-time records, 1871 to 1893)	1888 to Dec. 31, 1893.
B 131	Descriptions, measurements, gage heights, and ratings	1893 and 1894.
16th A, pt. 2	Descriptive information only	
B 140	Descriptions, measurements, gage heights, ratings, and monthly discharge (also many data covering earlier years).	1895.
W 11	Gage heights (also gage heights for earlier years)	1896.
18th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge (also similar data for some earlier years).	1895 and 1896.
W 15	Descriptions, measurements, and gage heights, eastern United States, eastern Mississippi River, and Missouri River above junction with Kansas.	1897.

Stream-flow data in reports of the United States Geological Survey—Continued.

Report.	Character of data.	Year.
W 16	Descriptions, measurements, and gage heights, western Mississippi River below junction of Missouri and Platte, and western United States.	1897.
19th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge (also some long-time records).	1897.
W 27	Measurements, ratings, and gage heights, eastern United States, eastern Mississippi River, and Missouri River.	1898.
W 28	Measurements, ratings, and gage heights, Arkansas River, and western United States.	1898.
20th A, pt. 4	Monthly discharge (also for many earlier years)	1898.
W 35 to 39	Descriptions, measurements, gage heights, and ratings	1899.
21st A, pt. 4	Monthly discharge	1899.
W 47 to 52	Descriptions, measurements, gage heights, and ratings	1900.
22d A, pt. 4	Monthly discharge	1900.
W 65, 66	Descriptions, measurements, gage heights, and ratings	1901.
W 75	Monthly discharge	1901.
W 82 to 85	Complete data	1902.
W 97 to 100	.....do	1903.
W 124 to 135	.....do	1904.
W 165 to 178	.....do	1905.
W 201 to 214	.....do	1906.
W 241 to 252	.....do	1907-8.
W 261 to 272	.....do	1909.
W 281 to 292	.....do	1910.
W 301 to 312	.....do	1911.
W 321 to 332	.....do	1912.
W 351 to 362	.....do	1913.
W 381 to 394	.....do	1914.
W 401 to 414	.....do	1915.
W 431 to 444	.....do	1916.
W 451 to 464	.....do	1917.

NOTE.—No data regarding stream flow are given in the 15th and 17th annual reports.

The records at most of the stations discussed in these reports extend over a series of years, and miscellaneous measurements at many points other than regular gaging stations have been made each year. An index of the reports containing records obtained prior to 1904 has been published in Water-Supply Paper 119.

The following table gives by years and drainage basins the numbers of the papers on surface-water supply published from 1899 to 1917. The data for any particular station will in general be found in the reports covering the years during which the station was maintained. For example, data from 1902 to 1917, for any station in the area covered by Part III are published in Water-Supply Papers 83, 98, 128, 169, 205, 243, 263, 283, 303, 323, 353, 383, 403, 433, and 453, which contain records for the Ohio River basin for those years.

Numbers of water-supply papers containing results of stream measurements, 1899–1917.

Year.	I North Atlantic slope basins (St. John River to York River).	II South Atlantic and eastern Gulf of Mexico basins [illegible]	III [illegible]	IV [illegible]	V [illegible]	VI [illegible]	VII [illegible]	VIII [illegible]	IX [illegible]	X [illegible]	XI [illegible]	XII A [illegible]	XII B [illegible]	XII C [illegible]
1899 a	35	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1900 g	47, h 48	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1901	65, 75	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1902	82	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1903	97	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1904	n 124, o 125, p 126	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	132	133	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1905	n 165, o 166, p 167	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1906	n 201, o 202, p 203	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	210	211	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1907–8	241	242	243	244	245	246	247	248	249	250, r 251	251	252	252	252
1909	261	262	263	264	265	266	267	268	269	270, r 271	271	272	272	272
1910	281	282	283	284	285	286	287	288	289	290	291	292	292	292
1911	301	302	303	304	305	306	307	308	309	310	311	312	312	312
1912	321	322	323	324	325	326	327	328	329	330	331	332 A	332 B	332 C
1913	351	352	353	354	355	356	357	358	359	360	361	362 A	362 B	362 C
1914	381	382	383	384	385	386	387	388	389	390	391	392	393	394
1915	401	402	403	404	405	406	407	408	409	410	411	412	413	414
1916	431	432	433	434	435	436	437	438	439	440	441	442	443	444
1917	451	452	453	454	455	456	457	458	459	460	461	462	463	464

a Rating tables and index to Water-Supply Papers 35–39 contained in Water-Supply Paper 39. Tables of monthly discharge for 1899 in Twenty-first Annual Report, Part IV.
b James River only.
c Gallatin River.
d Green and Gunnison rivers and Grand River above junction with Gunnison.
e Mohave River only.
f Kings and Kern rivers and south Pacific slope basins.
g Rating tables and index to Water-Supply Papers 47–52 and data on precipitation, wells, and irrigation in California and Utah contained in Water-Supply Paper 52. Tables of monthly discharge for 1900 in Twenty-second Annual Report, Part IV.
h Wissahickon and Schuylkill rivers to James River.
i Scioto River.
j Loup and Platte rivers near Columbus, Nebr., and all tributaries below junction with Platte.
k Tributaries of Mississippi from east.
l Lake Ontario and tributaries to St. Lawrence River proper.
m Hudson Bay only.
n New England rivers only.
o Hudson River to Delaware River, inclusive.
p Susquehanna River to Yadkin River, inclusive.
q Platte and Kansas rivers.
r Great Basin in California, except Truckee and Carson river basins.
s Below junction with Gila.
t Rogue, Umpqua, and Siletz rivers only.

In these papers and in the following lists the stations are arranged in downstream order. The main stem of any river is determined by measuring or estimating its drainage area—that is, the headwater stream having the largest drainage area is considered the continuation of the main stream, and local changes in name and lake surface are disregarded. All stations from the source to the mouth of the main stem of the river are presented first, and the tributaries in regular order from source to mouth follow, the streams in each tributary basin being listed before those of the next basin below.

In exception to this rule the records for Mississippi River are given in four parts, as indicated on page III, and the records for large lakes are presented in order of streams around the rim of the lake.

PART VI. MISSOURI RIVER BASIN.

PRINCIPAL STREAMS.

The principal streams in the Missouri River basin are Red Rock Creek and Beaverhead and Jefferson rivers, which may be considered a continuous river forming the head of the Missouri; and, below the mouth of the Jefferson, Madison, Gallatin, Prickly Pear, Little Prickly Pear, Dearborn, Sun, Marias, Judith, Musselshell, Milk, Yellowstone, Muddy, Little Missouri, Cheyenne, Niobrara, Platte (including North Platte and South Platte), Kansas, Osage (Marias des Cygnes), and Gasconade rivers. These streams drain wholly or in part the States of Colorado, Iowa, Kansas, Minnesota, Missouri, Montana, Nebraska, North Dakota, South Dakota, and Wyoming.

In addition to the annotated list of publications relating specifically to the section, these pages contain a similar list of reports that are of general interest in many sections and cover a wide range of hydrologic subjects, and also brief references to reports published by State and other organizations. (See p. XXVIII.)

GAGING STATIONS.

NOTE.—Dash after a date indicates that station was being maintained September 30, 1917; period after a date indicates discontinuance. Tributaries are shown by indention.

Red Rock Creek (head of Missouri River) above Red Rock reservoir, near Monida, Mont., 1911; 1914–15.
Red Rock Creek below Red Rock reservoir, near Monida, Mont., 1911–
Red Rock Creek at Lima, Mont., 1907–1911.
Red Rock Creek at Red Rock, Mont., 1890.
Beaverhead River (continuation of Red Rock Creek) at Barratts, Mont., 1907–
Beaverhead River at Dillon, Mont., 1907.
Jefferson River (continuation of Red Rock-Beaverhead River) near Silverstar, Mont., 1910–1916.
Jefferson River at Sappington, Mont., 1894–1905.
Missouri River at Toston, Mont., 1890; 1910–1916.
Missouri River near Townsend, Mont., 1891–1901; 1903–4.
Missouri River at Canyon Ferry, Mont., 1889.
Missouri River near Craig, Mont., 1890–1892.
Missouri River at Cascade, Mont., 1902–1915.
Missouri River at Great Falls, Mont., 1897–1905.
Missouri River at Fort Benton, Mont., 1910–
Missouri River near Williston, N. Dak., 1905–1907.
Missouri River at Mannhaven, N. Dak., 1904.
Missouri River at Washburn, N. Dak., 1905.
Missouri River at Bismarck, N. Dak., 1904–5.
Missouri River at Kansas City, Mo., 1905–6.

Missouri River tributaries:
- Passamari River [Ruby Creek] near Alder, Mont., 1911–1914.
- Bighole River near Dewey, Mont., 1910–1913.
- Big pipestone Creek near Whitehall, Mont., 1910–11.
- Whitetail Creek near Whitehall, Mont., 1911.
  - Little Whitetail Creek near Whitehall, Mont., 1911.
- Boulder River.
  - Muskrat Creek near Boulder, Mont., 1912–1914.
- Gibbon River (head of Madison River) near Yellowstone, Mont., 1913–1916.
- Madison River near Yellowstone, Mont., 1913–
- Madison River near Norris, Mont., 1897–1905; 1910.
- Madison River near Red Bluff, Mont., 1890–1894; 1897–1902.
- Madison River near Three Forks, Mont., 1893–1897.
- Gallatin River near Salesville, Mont., 1895–1905; 1910–1913.
- Gallatin River near Bozeman, Mont., 1889–1891.
- Gallatin River at Logan, Mont., 1893–1905.
  - Middle Creek near Bozeman, Mont., 1895–96; 1898–1900; 1902–3.
- Crow Creek near Townsend, Mont., 1912–13.
- Crow Creek near Radersburg, Mont., 1901.
- Deep Creek near Townsend, Mont., 1910–1915.
- Prickly Pear Creek near Clancy, Mont., 1908–1916.
- Prickly Pear Creek at East Helena, Mont., 1908–1913.
  - Lump Gulch Creek near Clancy, Mont., 1908–1913.
  - Tenmile Creek near Rimini, Mont., 1915–
  - Tenmile Creek near Helena, Mont., 1908–
    - Sevenmile Creek at Birdseye, Mont., 1908–1913.
- Little Prickly Pear Creek near Marysville, Mont., 1909–1911; 1913–
- Little Prickly Pear Creek near Cayon Creek, Mont., 1909–1911; 1913–
  - Lost Horse Creek near Marysville, Mont., 1909–1911.
  - Marsh Creek near Marysville, Mont., 1909–1911.
  - Deadman Creek near Marysville, Mont., 1909–1911.
- Dearborn River near Clemons, Mont., 1908–1911.
  - Falls Creek near Clemons, Mont., 1908–1911.
- Smith River at Truly, Mont., 1905–1907.
- Sun River, North Fork of North Fork (head of Sun River), near Augusta, Mont., 1911–12.
- Sun River, North Fork, near Augusta,[1] Mont., 1889–90; 1903–
- Sun River at Fort Shaw, Mont., 1912–
- Sun River at Sun River, Mont., 1905–1912.
- Sun River near Great Falls, Mont., 1897.
  - South Fork of North Fork of Sun River near Augusta, Mont., 1911–12.
  - Floweree Big canal near Fort Shaw, Mont., 1912.
  - Willow Creek near Augusta, Mont., 1905–1911; 1912–
  - South Fork of Sun River at Augusta, Mont., 1904–
    - Smith Creek near Augusta, Mont., 1906–1912.
      - Ford Creek near Augusta, Mont., 1906–1912.
  - Crown Butte canal at Riebling, Mont., 1912.
  - Crown Butte canal near Simms, Mont., 1912.
  - Sun River canal near Sun River, Mont., 1912.
  - Sun River canal at Vaughn, Mont., 1912.

[1] Records for 1889–90 published at Sun River above Augusta, Mont.

Missouri River tributaries—Continued.
- Belt Creek near Belt, Mont., 1905–6.
- Highwood Creek near Highwood, Mont., 1905–6.
- Two Medicine River (head of Marias River) near Midvale, Mont., 1902–3.
- Two Medicine River at Family, Mont., 1907–
- Marias River near Shelby, Mont., 1902–1908; 1911–.
  - Badger Creek near Family, Mont., 1907–
  - Birch Creek at Swift dam, near Dupuyer, Mont., 1913–
  - Birch Creek near Dupuyer, Mont., 1907–
  - Birch Creek at Nelson's ranch, near Dupuyer, Mont., 1914–
  - Birch Creek at Hall's ranch, near Dupuyer, Mont., 1913–1916.
  - Birch Creek at Robare, Mont., 1914–
    - Dupuyer Creek at Dupuyer, Mont., 1908–1912.
    - Dupuyer Creek near Valier, Mont., 1912–
  - Cut Bank Creek at Cut Bank, Mont., 1905–
  - Dry Fork of Marias River near Valier, Mont., 1911–1915.
  - Teton River at Strabane, near Belleview, Mont., 1904–1906; 1908–
  - Teton River near Chouteau, Mont., 1904–1906; 1913; 1915–
  - Spring Creek near Strabane, Mont., 1913; 1917–
  - Spring Creek near Chouteau, Mont., 1917–
    - Deep Creek at Frazier's ranch, near Chouteau, Mont., 1912.
    - Deep Creek near Chouteau, Mont., 1911–
      - Willow Creek near Chouteau, Mont., 1912–
  - Muddy Creek near Bynum, Mont., 1912–
  - Muddy Creek near Agawam, Mont., 1917.
    - Blackleaf Creek near Bynum, Mont., 1912–
- Judith River near Lewistown, Mont., 1910.
- Musselshell River, North Fork (head of Musselshell River), near Delpine, Mont., 1909–1911.
- Musselshell River, North Fork, near Martinsdale, Mont., 1907–1914.
- Musselshell River at Harlowtown, Mont., 1907–
- Musselshell River at Shawmut, Mont., 1902–1907.
- Musselshell River at Lavina, Mont., 1906.
  - Checkerboard Creek near Delpine, Mont., 1909–1911; 1913–14.
  - South Fork of Musselshell River near Martinsdale, Mont., 1907–1914.
  - American Fork near Harlowton, Mont., 1907–1911; 1913.
    - Lebo Creek near Harlowton, Mont., 1907–1911; 1913.
  - Boxelder Creek:
    - Flatwillow Creek near Flatwillow, Mont., 1911–
- Milk River, South Fork (head of Milk River), near international boundary, 1905–
- Milk River at eastern crossing [international boundary], 1913–
- Milk River at Havre, Mont., 1898–
- Milk River at Chinook, Mont., 1897.
- Milk River at Malta, Mont., 1902–
- Milk River at Hinsdale, Mont., 1908–1914.
- Milk River near Vandalia, Mont., 1915–
  - North Fork of Milk River near Browning, Mont., 1911–12.
  - North Fork of Milk River near international boundary [Kimball, Alberta], 1913–
  - Fort Belknap canal near Chinook, Mont., 1903–
  - Winter-Anderson canal near Chinook, Mont., 1906; 1908.
  - Lodge Creek at international boundary, 1917–

- Missouri River tributaries—Continued.
  - Milk River tributaries—Continued.
    - Lodge Creek[1] at Chinook, Mont., 1906–1908.
      - Reser ditch near Chinook, Mont., 1905–6.
      - West Fork ditch near Chinook, Mont., 1905–6.
    - Battle Creek at international boundary, 1917–
    - Battle Creek[2] near Chinook, Mont., 1905–
      - Cook canal near Chinook, Mont., 1905–
      - Matheson canal near Chinook, Mont., 1905–
    - Paradise Valley canal near Chinook, Mont., 1903–
    - Harlem canal near Zurich, Mont., 1903–
    - Agency ditch near Harlem, Mont., 1905–
    - Frenchman Creek near international boundary, 1917–
    - Beaver Creek near Malta, Mont., 1917–
    - Beaver Creek overflow near Bowdoin, Mont., 1903–1906; 1908–1912.
    - Beaver Creek near Saco (Ashfield), Mont., 1903–1906; 1908–1912.
    - Rock Creek near Hinsdale, Mont., 1905–1907; 1912–
      - Rock Creek canal near Hinsdale, Mont., 1905–1907.
    - Porcupine Creek at Nashua, Mont., 1908–
  - Little Porcupine Creek near Frazer, Mont., 1908–1916.
  - Wolf Creek near Wolf Point, Mont., 1908–1914.
    - Wolf Point ditch at Wolf Point, Mont., 1909.
  - Poplar River near Poplar, Mont., 1908–
  - Big Muddy Creek near Culbertson, Mont., 1908–
  - Yellowstone River near Canyon Hotel, Yellowstone National Park, 1913–
  - Yellowstone River at Corwin Springs, Mont., 1910–
  - Yellowstone River near Horr, Mont., 1889–1893.
  - Yellowstone River at Livingston, Mont., 1897–1905.
  - Yellowstone River at Billings, Mont., 1904–5.
  - Yellowstone River at Huntley, Mont., 1907–1916.
  - Yellowstone River at Junction, Mont., 1906–7.
  - Yellowstone River near Glendive, Mont., 1897–1910.
  - Yellowstone River at Intake, Mont., 1911–
    - Big Timber Creek, North Fork (head of Big Timber Creek), near Big Timber, Mont., 1907–1911.
    - Big Timber Creek near Big Timber, Mont.;, 1912–
      - South Fork of Big Timber Creek near Big Timber, Mont., 1907–1911.
    - Boulder River near Contact, Mont., 1910–1916.
    - Boulder River near McLeod, Mont., 1912–1914.
      - East Fork of Boulder River near McLeod, Mont., 1907–1909.
      - West Fork of Boulder River near Bruffeys, Mont., 1904–1910.
      - West Fork of Boulder River at McLeod, Mont., 1907–1914.
    - Sweetgrass Creek above Melville, Mont., 1907–
    - Sweetgrass Creek below Melville, Mont., 1907–
    - Stillwater River near Nye, Mont., 1911–1913.
    - Stillwater River near Absarokee, Mont., 1910–1914.
      - Woodbine Creek near Nye, Mont., 1911–1913.
      - Rosebud Creek at Absarokee, Mont., 1910–1914.
    - Clark Fork at Fromberg, Mont., 1905–1913.
    - Pryor Creek at Coburn, Mont., 1911–
    - Pryor Creek at Huntley, Mont., 1904–1916.
    - Wind River (head of Big Horn River) at Dubois, Wyo., 1910–1912.
    - Wind River near Wind River, Wyo., 1909.

[1] Formerly called West Fork of Milk River. [2] Formerly called North Fork of Milk River.

- Missouri River tributaries—Continued.
  - Yellowstone River tributaries—Continued.
    - Powder River tributaries—Continued.
      - Clear Creek near Arvada, Wyo., 1915–
        - Piney Creek at Kearney, Wyo., 1902–1906; 1911–12; 1915–1917.
        - Piney Creek at Ucross, Wyo., 1917–
          - Cruez ditch near Story, Wyo., 1903.
  - Muddy River near Williston, N. Dak., 1904–1909.
  - Little Missouri at Alzada, Mont., 1904–1906.
  - Little Missouri River near Alzada, Mont., 1911–
  - Little Missouri River at Camp Crook, S. Dak., 1903–1906.
  - Little Missouri River at Medora, N. Dak., 1903–1908.
  - Knife River near Broncho, N. Dak., 1903–
  - Painted Woods Creek near Washburn, N. Dak., 1909–10.
    - Turtle Creek near Washburn, N. Dak., 1909–10.
  - Heart River near Richardton, N. Dak., 1903–
  - Apple Creek near Bismarck, N. Dak., 1905.
  - Cannonball River at Stevenson, N. Dak., 1903–1908; 1911–
  - Grand River, North Branch (head of Grand River), at Haley, N. Dak., 1908–1917.
  - Grand River near Seim, S. Dak., 1904–1906.
  - Grand River near Wakpala, S. Dak., 1911–
  - Moreau [Owl] River near Bixby, S. Dak., 1904–1906.
  - Cheyenne River at Edgemont, S. Dak., 1903–1906.
  - Cheyenne River near Hot Springs [Cascade Springs], S. Dak., 1914–
  - Cheyenne River near Wasta, S. Dak., 1914–15.
    - Beaver Creek near Edgemont, S. Dak., 1905–6.
    - Hat Creek near Edgemont, S. Dak., 1905–6.
    - Battle Creek near Hermosa, S. Dak., 1903.
    - Spring Creek near Rapid, S. Dak., 1903–1905.
    - Rapid Creek at Big Bend, S. Dak., 1915–1917.
    - Rapid Creek at Rapid, S. Dak., 1903–1906.
    - Boxelder Creek at Blackhawk, S. Dak., 1903–1905.
      - Corbin-Morse ditch at Rapid, S. Dak., 1906.
    - Elk Creek near Piedmont, S. Dak., 1903.
    - Belle Fourche River at Belle Fourche, S. Dak., 1903–1906.
    - Belle Fourche River near Belle Fourche, S. Dak., 1906; 1912–
      - Redwater River near Minnesela, S. Dak., 1903.
      - Redwater River at Belle Fourche, S. Dak., 1903–1906.
        - Spearfish Creek near Spearfish, S. Dak., 1903–1906.
        - Redwater ditch at Minnesela, S. Dak., 1904–1906.
      - Crow Creek near Belle Fourche, S. Dak., 1904.
      - Owl Creek near Belle Fourche, S. Dak., 1904.
      - Indian Creek near Belle Fourche, S. Dak., 1904.
  - White River at Crawford, Nebr., 1897.
  - White River near Interior, S. Dak., 1904–1906; 1911–
  - White River near Westover, S. Dak., 1911–
    - South Fork of White River near Westover, S. Dak., 1912–
  - Niobrara River near Valentine (Fort Niobrara), Nebr., 1897; 1899; 1901–1906.
  - Niobrara River near Spencer, Nebr., 1908.
  - Niobrara River near Lynch, Nebr., 1913–1915.
  - Niobrara River at Niobrara, Nebr., 1902; 1910–1913.
    - Red Deer Lake (on Plum Creek) near Woodlake, Nebr., 1904–5.
  - James River near Lamoure, N. Dak., 1903.

Missouri River tributaries—Continued.
- Big Sioux River near Watertown, S. Dak., 1900–1903.
- Big Sioux River near Sioux Falls, S. Dak., 1900–1901.
  - Rock River at Luverne, Minn., 1911–1914.
- Grizzly Creek, continuation of Colorado Creek (head of North Platte River) near Hebron, Colo., 1904–5.
- North Platte River near North Gate, Colo., 1915–
- North Platte River near Hebron, Colo., 1904–5.
- North Platte River near Cowdrey, Colo., 1904–5.
- North Platte River near Pinkhampton, Colo., 1904.
- North Platte River at Saratoga, Wyo., 1903–1906; 1909; 1911–12; 1915–
- North Platte River above Pathfinder, Wyo., 1913–
- North Platte River at Pathfinder, Wyo., 1905–
- North Platte River at Alcova., Wyo., 1904–5.
- North Platte River near Casper, Wyo., 1917–
- North Platte River near Douglas, Wyo., 1894.
- North Platte River near Orin Junction, Wyo., 1894–1900.
- North Platte River at McKinley, Wyo., 1917–
- North Platte River at Guernsey, Wyo., 1900–1908; 1912.
- North Platte River above and below Whalen, Wyo.,[1] 1909–
- North Platte River near Fort Laramie, Wyo., 1887–1890.
- North Platte River at Henry, Nebr., 1912–1916.
- North Platte River near Mitchell, Nebr., 1901–1913.
- North Platte River at Scottsbluff, Nebr., 1912,
- North Platte River near Gering, Nebr., 1897–1900.
- North Platte River near Camp Clark, Nebr., 1896–1900.
- North Platte River at Bridgeport, Nebr., 1902–1906; 1915.
- North Platte River at North Platte, Nebr., 1895–1915.
- Platte River near Lexington, Nebr., 1902–1906.
- Platte River near Elm Creek, Nebr., 1914–15.
- Platte River near Columbus, Nebr., 1895–1915.
- Platte River near Fremont. Nebr., 1913–1915.
- Platte River near Leshara, Nebr., 1911–1913.
- Platte River near South Bend, Nebr., 1903.
  - Little Grizzly Creek at Hebron, Colo., 1904–5.
  - Roaring Fork of North Platte River near Hebron, Colo., 1904–5.
  - North Fork of North Platte River at Higho, Colo., 1904–5.
  - Middle Fork of North Platte River:
    - Michigan Creek near Walden, Colo., 1904–5.
    - Michigan Creek near Cowdrey, Colo., 1904–5.
  - Canadian River at Cowdrey, Colo., 1904–5.
  - Douglas Creek near Keystone, Wyo., 1912; 1914–1916.
  - Mullen Creek near French, Wyo., 1911.
  - Big Creek near Big Creek (Downington), Wyo., 1911–12; 1915–
  - French Creek near French, Wyo., 1911–12; 1915–
  - Brush Creek near Saratoga, Wyo., 1911–12; 1915.
  - Encampment River near Peryam's ranch, Wyo., 1900.
  - Encampment River at Encampment, Wyo., 1911–12; 1915–
  - Cow Creek near Saratoga, Wyo., 1911–12.
  - Spring Creek near Saratoga, Wyo., 1911–12.
    - North Spring Creek near Saratoga, Wyo., 1913–1915.
  - Jack Creek at Matheson's ranch, near Saratoga, Wyo., 1913–1917.
  - Jack Creek at Blydenburg's ranch, near Saratoga, Wyo., 1912.

[1] Formerly North Platte River and Interstate canal at Whalen, Wyo.

Missouri River tributaries—Continued.
  Platte River tributaries—Continued.
    Jack Creek at Burdick's ranch, near Saratoga, Wyo., 1911–12.
    Pass Creek near Walcott, Wyo., 1911.
    Medicine Bow River near Medicine Bow, Wyo., 1901; 1911–12; 1915–1917.
      Rock Creek near Arlington, Wyo., 1911–
      Rock Creek near Rock River, Wyo., 1911–12.
        Deep Creek near Arlington, Wyo., 1914–
      Little Medicine Bow River:
        Muddy Creek near Shirley, Wyo., 1915–1917.
    Sage Creek above Pathfinder reservoir, Wyo., 1915–
    Deweese Creek near Alcova, Wyo., 1917–
    Sand Creek above Alcova, Wyo., 1915–
    Sweetwater River near Splitrock, Wyo., 1902–3.
    Sweetwater River near Alcova, Wyo., 1913–
      Horse Creek near Alcova, Wyo., 1915–
    Canyon Creek near Alcova, Wyo., 1915–
    Bates Creek near Casper, Wyo., 1916–
    Deer Creek at Glenrock, Wyo., 1916–
    Boxelder Creek near Careyhurst, Wyo., 1911; 1916–
    La Prele Creek near Fetterman, Wyo., 1916.
    Wagon Hound Creek near La Bonte, Wyo., 1916–
    La Bonte Creek near La Bonte, Wyo., 1916–
    Horseshoe Creek near Glendo, Wyo., 1916–
    Cottonwood Creek near Wendover, Wyo., 1916–
    Laramie River at Glendevey, Colo., 1904–5; 1910–1913; 1916.
    Laramie River near Jelm, Wyo., 1904–5; 1911–
    Laramie River near Woods Landing, Wyo., 1895–1900; 1911.
    Laramie River and Pioneer canal near Woods, Wyo., 1912; 1914–
    Laramie River at Two Rivers, Wyo., 1911–
    Laramie River near Lookout, Wyo., 1915–1917.
    Laramie River at McGill, Wyo., 1915.
    Laramie River below McGill, Wyo., 1916–1917.
    Laramie River near Wheatland, Wyo., 1912; 1915–16.
    Laramie River near Uva, Wyo., 1895–1900; 1903.
    Laramie River at Fort Laramie, Wyo., 1915–
      McIntyre Creek near Gleneyre, Colo., 1904–5.
      Little Laramie River near Hatton, Wyo., 1902–3.
      Little Laramie River near Filmore, Wyo., 1911–12; 1915–
      Little Laramie River near Laramie, Wyo., 1903.
      Little Laramie River at Two Rivers, Wyo., 1911–
      Sibylee Creek near Wheatland, Wyo., 1912; 1915–16.
      North Laramie River near Wheatland, Wyo., 1912; 1914–
      North Laramie River at Uva, Wyo., 1911–12.
      Chugwater Creek at Chugwater, Wyo., 1911–12; 1915–
    Horse Creek near Little Horse Creek, Wyo., 1911–12.
    Horse Creek near La Grange, Wyo., 1911–12; 1915–
    Birdwood Creek near Sutherland, Nebr., 1913–1915.
    South Platte River at Lake George, Colo., 1910–1915.
    South Platte River at Cheeseman Lake, Colo., 1899; 1901.
    South Platte River above North Fork, at South Platte, Colo., 1905–1912.
    South Platte River at South Platte, Colo., 1902–
    South Platte River near Deansbury (Platte Canyon), Colo., 1887–1892; 1895–1900; 1903.

Missouri River tributaries—Continued.
  Platte River tributaries—Continued.
    South Platte River at Denver, Colo., 1895–1906; 1909–1913.
    South Platte River near Kersey, Colo., 1901–1903; 1905–1913.
    South Platte River near Orchard, Colo., 1895–1900.
    South Platte River at Julesburg, Colo., 1902–1906; 1908–1914.
    South Platte River near Big Spring, Nebr., 1902–3.
    South Platte River at North Platte, Nebr., 1914–1915.
      Little South Platte River near Fairplay, Colo., 1916.
      Middle Fork of South Platte River at Alma, Colo., 1916.
      Middle Fork of South Platte River at Fairplay, Colo., 1910–1912; 1916.
      Tarryall Creek near Como, Colo., 1911–12.
      Tarryall Creek near Jefferson, Colo., 1910–1917.
      Tarryall Creek near Hayman, Colo., 1910–1912.
        Jefferson Creek at Jefferson, Colo., 1910–1912.
          Michigan Creek near Jefferson, Colo., 1910–1912.
        Rock Creek near Jefferson, Colo., 1916.
      Goose Creek near Cheeseman Lake, Colo., 1899.
      North Fork of South Platte River at Grant, Colo., 1910–
      North Fork of South Platte River at Cassells, Colo., 1908–1913.
      North Fork of South Platte River at South Platte, Colo., 1909–10; 1913–
        Geneva Creek above Jackwhacker Creek, near Grant, Colo., 1909–1911.
        Geneva Creek at Old Geneva smelter, near Grant, Colo., 1909–1911.
        Geneva Creek at Sullivan's ranch, near Grant, Colo., 1908–1911.
        Geneva Creek at Grant, Colo., 1911–
          Smelter Creek at Old Geneva smelter, near Grant, Colo., 1909–1911.
          Duck Lake Creek near Grant, Colo., 1909–1911.
          Scott Gomer Creek at Sullivan's ranch, near Grant, Colo. 1909–1913.
      Bear Creek near Morrison, Colo.,[1] 1888–1891; 1895–1902.
      Clear Creek at Idaho Springs, Colo., 1910–1912.
      Clear Creek at Forkscreek, Colo., 1899–1912.
      Clear Creek near Golden, Colo., 1887–88; 1908–9; 1911–
      St. Vrain Creek at Lyons, Colo.,[1] 1888–1892; 1895–1903; 1909–1913.
        Boulder Creek at Orodell, Colo.,[2] 1887–1890; 1907–1913.
        Boulder Creek near Boulder, Colo.,[1] 1888–1892; 1895–1901; 1907–1909.
          North Boulder Creek at Silver Lake, Colo., 1913–
          South Boulder Creek near Rollinsville, Colo., 1910–
          South Boulder Creek at Eldorado Springs (near Marshall), Colo. 188–1892; 1895–1901; 1909–1913.
            Community canal near Marshall, Colo., 1909.
      Big Thompson Creek near Drake, Colo., 1917–
      Big Thompson Creek near Arkins, Colo.,[1] 1888–1892; 1895–1911.
        Handy ditch near Arkins, Colo., 1899–1900; 1903.
      Cache la Poudre River near Elkhorn, Colo., 1909–1911.
      Cache la Poudre River near Fort Collins, Colo., 1909–1911.
      Cache la Poudre River at mouth of canyon near Fort Collins, Colo., 1884–1901; 1910–1913.
      Cache la Poudre River near Greeley, Colo., 1903.
      Crow Creek:
        Middle Fork of Crow Creek near Hecla, Wyo., 1902.

[1] Published only in Water-Supply Paper 74.
[2] Published as "North Boulder Creek above Boulder" in Thirteenth Ann. Rept., pt. 3.

Missouri River tributaries—Continued.
  Platte River tributaries—Continued.
    Middle Loup River (head of Loup River) near St. Paul, Nebr., 1895; 1897; 1899; 1903.
    Loup River at Columbus, Nebr., 1894–1915..
      North Loupe River near St. Paul, Nebr., 1895; 1897; 1899; 1903.
    Elkhorn River at Norfolk, Nebr., 1896–1903.
    Elkhorn River at Arlington, Nebr., 1899–1903; 1913–1915.
    Elkhorn River at Waterloo, Nebr., 1911–1913.
  Republican River, North Fork (head of Kansas River), near Haigler, Nebr., 1896.
  Republican River, North Fork, near Benkelman, Nebr., 1894–95; 1903–1906.
  Republican River at Culbertson, Nebr., 1913–1915.
  Republican River at Bostwick, Nebr., 1904–1915.
  Republican River near Superior, Nebr., 1896–1903.
  Republican River at Wakefield, Kans., 1917–
  Republican River at Junction, Kans., 1895–1905.
  Kansas River at Ogden, Kans., 1917–
  Kansas River near St. George, Kans., 1904.
  Kansas River at Topeka, Kans., 1904; 1917–
  Kansas River at Lecompton, Kans., 1899–1906.
  Kansas River near Lawrence, Kans., 1895–1899.
  Kansas River at Bonner Springs, Kans., 1917–
    South Fork of Republican River at Benkelman, Nebr., 1894–95; 1903–1906.
    Frenchman Creek near Wauneta, Nebr., 1895–96.
    Frenchman Creek near Palisade, Nebr., 1894–1896.
    Frenchman Creek at Culbertson, Nebr., 1913–1915.
    Smoky Hill River at Ellsworth, Kans., 1895–1905.
    Smoky Hill River at Solomon, Kans., 1904.
      Beaver (Ladder) Creek near Scott City, Kans., 1904–5.
      Saline River near Beverly, Kans., 1895–1897.
      Saline River near Salina, Kans., 1897–1903.
      Solomon River at Beloit, Kans., 1895–1897.
      Solomon River near Niles, Kans., 1897–1903.
    Big Blue River (head of Blue River) at Beatrice, Nebr., 1910–1915.
    Blue River at Manhattan, Kans., 1895–1905.
      Little Blue River at Blue Bluff, Nebr., 1912.
      Little Blue River near Fairbury, Nebr., 1908–1915.
  Osage (Marias des Cygnes) River at Ottawa, Kans., 1902–1905.
  Gasconade River at Arlington, Mo., 1903–1906.
    Piney Fork of Gasconade River near Houston, Mo., 1908–9.
    Piney Fork of Gasconade River near Hooker, Mo., 1903. (Also called Big Piney Creek.)
    Little Piney Creek near Arlington, Mo., 1903.

REPORTS ON WATER RESOURCES OF THE MISSOURI RIVER BASIN.

PUBLICATIONS OF UNITED STATES GEOLOGICAL SURVEY

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*5. Irrigation practice on the Great Plains, by E. B. Cowgill. 1897. 39 pp., 12 pls. 10c.

Describes reservoirs for storm and pumped waters, ditching, methods of distributing water, cultivation and subirrigation, duty of water, and winter irrigation.

*9. Irrigation near Greeley, Colo., by David Boyd. 1897. 90 pp., 21 pls.

Treats of topography, rainfall, and water supply in the valley of Cache la Poudre River, a tributary of the South Platte; describes the canals and reservoir system, construction and operation of canals, and agricultural practice; discusses also the legislative and judicial control of the waters; speaks of the use of the underground water, effect of alkali waters on soil, pumping of underground waters, and artesian wells.

*12. Underground waters of a portion of southeastern Nebraska, by N. H. Darton. 1898. 56 pp., 21 pls.

Discusses physiography, geology, underground waters of moderate depth, and water horizons in Lancaster, Seward, northern Saline, York, Fillmore, Hamilton, Clay, Hall, Adams, Buffalo, Kearney, Phelps, northern Gosper, and eastern and central Dawson counties; reviews briefly the prospects for obtaining deeper-seated waters.

*23. Water-right problems of the Big Horn Mountains, by Elwood Mead. 1899. 62 pp., 7 pls. 10c.

Discusses water divisions, districts, appropriations, reservoirs, and administrative questions.

*29. Wells and windmills in Nebraska, by E. H. Barbour. 1899. 85 pp., 27 pls. 15c.

Describes home-made windmills; discusses briefly action of water underground, transmission and storage of windmill power, precipitation, surface waters for irrigation, supply for cities and towns, salt water, and blowing wells.

*34. Geology and water resources of a portion of southeastern South Dakota, by J. E. Todd. 1900. 34 pp., 10 pls. 10c.

Describes areas in Turner, Hutchinson, Bonhomme, Yankton, and Clay counties, including typical sections of the valleys of James and Vermillion rivers.

*44. Profiles of rivers in the United States, by Henry Gannett. 1901. 100 pp., 11 pls.

Gives elevations and distances along rivers of the United States, including Missouri, Jefferson, Bighole, Beaverhead, Madison, Gallatin, Osage, Kansas, Republican, Platte, Yellowstone, Milk, and James rivers; also brief descriptions of many of the streams. Arrangement geographic. Many river profiles are scattered through other reports on surface waters in various parts of the United States.

*57. Preliminary list of deep borings in the United States, Part I (Alabama-Montana), by N. H. Darton. 1902. 60 pp. 5c.

*61. Preliminary list of deep borings in the United States, Part II (Nebraska-Wyoming), by N. H. Darton. 1902. 67 pp. 5c.

A second, revised, edition was published in 1905 as Water-Supply Paper 149 (q. v.).

*70. Geology and water resources of the Patrick and Goshen Hole quadrangles, in eastern Wyoming and western Nebraska, by G. I. Adams. 1902. 50 pp., 11 pls. 15c.

Describes the geologic formation, surface features, water supply (surface and underground, irrigation, and agricultural products of a part of the Great Plains; discusses settlement and occupancy of public lands, and in an appendix gives the text of the "desert-lands" act, the Carey act, and an act for the construction of reservoirs on public lands for the watering of stock.

74. Water resources of the State of Colorado, by A. L. Fellows. 1902. 151 pp., 14 pls. 25c.

Discusses under South Platte, Arkansas, Rio Grande, San Juan, Grand, and Green River irrigation divisions, drainage, and irrigation, and gives records of stream flow.

90. Geology and water resources of part of the lower James River Valley, South Dakota, by J. E. Todd and C. M. Hall. 1904. 47 pp., 23 pls. 35c.

Describes topography, geologic formations, and surface and underground waters of Davison, Hanson, Sanborn, Beadle, and Miner counties, and portions of Kingsbury, Jerauld, Aurora, and McCook counties, S. Dak.

93. Proceedings of first conference of engineers of the Reclamation Service, with accompanying papers, compiled by F. H. Newell, chief engineer. 1904. 361 pp. 25. [Inquiries concerning this report should be addressed to the Reclamation Service.] Contains:

Irrigation in North Dakota by pumping, by F. A. Wilder. Discusses the use of lignite as a fuel for the operation of farm engines.

South Dakota investigations, by Raymond F. Walter. Mentions surveys of reservoir sites on creeks north of Rapid City and the water supply of the Belle Fourche project.

Work on North Platte River in Wyoming, by John E. Field.

Investigations in Wyoming, by Jeremiah Ahern. Describes the Lake De Smet and the Shoshone projects.

Reclamation and water storage in Nebraska, by O. V. P. Stout. Describes North Platte River and discusses its possible use for irrigation. Gives tables showing monthly discharge of the river from 1895 to 1902 and the volume of storage necessary to insure water to meet possible demands. Describes also Frenchman, Loup, and Niobrara rivers.

96. Destructive floods in the United States in 1903, by E. C. Murphy. 1904. 81 pp., 13 pls. 15c.

Gives notes on early floods in Mississippi Valley, and describes floods on Kansas River and its tributaries (Blue, Republican, Solomon, Saline, and Smoky Hill rivers); gives an account of the losses and suggests methods of flood prevention; contains also discharge tables and compares flood and ordinary data.

102. Contributions to the hydrology of eastern United States, 1903; M. L. Fuller, geologist in charge. 1904. 522 pp. 30c.

Contains brief reports on wells and springs of Minnesota and Missouri. The reports comprise tabulated well records giving information as to location, owner, depth, yield, head, etc., supplemented by notes as to elevation above sea, materials penetrated, temperature, use and quality; many miscellaneous analyses.

*103. A review of the laws forbidding pollution of inland waters in the United States, by E. B. Goodell. 1904. 120 pp. Superseded by 152.

Cites statutory restriction of water pollution.

*110. Contributions to the hydrology of eastern United States, 1904; M. L. Fuller, geologist in charge. 1905. 211 pp., 5 pls. 10c.

Contains a brief report on the "Spring system of the Decaturville dome, Camden County Mo.," by E. M. Shepard. Some of these springs are of immense size and present many points of interest.

*114. Underground waters of eastern United States; M. L. Fuller, geologist in charge. 1905. 285 pp., 18 pls. 25c.

Contains brief reports as follows:

Missouri, by E. M. Shepard.

Iowa, by W. H. Norton.

Each of these reports describes briefly the topography of the area, the relation of the geology to the water supplies, and gives list of pertinent publications; lists also principal mineral springs.

117. The lignite of North Dakota and its relation to irrigation, by F. A. Wilder. 1905. 59 pp., 8 pls. 10c.

Describes the thickness, extent, variations, and fuel value of the lignite and its use for pumping water, the area, soils, and lignite of the river flats, and the status of irrigation in the State.

*122. Relation of the law to underground waters, by D. W. Johnson. 1905. 55 pp. 5c.

Cites legislative acts relating to ground waters in Colorado, Nebraska, South Dakota, and Wyoming.

146. Proceedings of second conference of engineers of the Reclamation Service, with accompanying papers, compiled by F. H. Newell, chief engineer. 1905. 267 pp. 15c. [Inquiries concerning this report should be addressed to the Reclamation Service.]

Contains brief account of the organization of the hydrographic (water-resources) branch and the Reclamation Service, reports of conferences and committees, circulars of instruction, and many brief reports on subjects closely related to reclamation, and a bibliography of technical papers by members of the service.

A brief report on "Irrigation development in North Dakota," by H. A. Storrs. Discusses the feasibility of pumping water from the Missouri to irrigate bench lands along its banks.

147. Destructive floods in United States in 1904, by E. C. Murphy and others. 1905. 206 pp., 18 pls. 15c. Contains:

Belle Fourche River flood, South Dakota, from report of R. F. Walter. Describes floods on Belle Fourche River (tributary to the Missouri through Cheyenne River) and on Cache la Poudre River and Crow Creek (tributaries of the South Platte).

*149. Preliminary list of deep borings in United States, second edition, with additions, by N. H. Darton. 1905. 175 pp. 10c.

Gives, by States (and within the States by counties), location, depth, diameter, yield, height of water, and other available information, concerning wells 400 feet or more in depth; includes all wells listed in Water-Supply Papers 57 to 61; mentions also principal publications relating to deep borings.

*152. A review of the laws forbidding pollution of inland waters in the United States (second edition), by E. B. Goodell. 1905. 149 pp. 10c.

Cites statutory restrictions of water pollution in Colorado, Iowa, Kansas, Minnesota, Missouri Nebraska, North and South Dakota, and Wyoming.

*162. Destructive floods in the United States in 1905, with a discussion of flood discharge and frequency and an index to flood literature, by E. C. Murphy and others. 1906. 105 pp., 4 pls. 15c.

Gives accounts of floods in eastern Missouri and South Dakota, and estimates of floods discharge and frequency on Kansas, Loup, and Platte rivers; contains also index to literature on floods in American streams.

*184. The underflow of the South Platte Valley, by C. S. Slichter and H. C. Wolff. 1906. 42 pp. 5c.

Describes investigations of velocity, direction, quantity of underflow, and the underflow ditch at Ogalalla, Nebr., gives chemical analyses of the water, and discusses disadvantages of underflow canals; describes also the investigation at North Platte, Nebr., and gives suggestions for construction of small pumping plants.

*195. Underground waters of Missouri, their geology and utilization, by E. M. Shepard. 1907. 224 pp., 6 pls. 30c.

Describes the topography and geology of the State, the waters of the various formations, and discusses the water supplies by districts and counties; gives statistics of city water supplies, analyses of waters, and many well records.

*215. Geology and water resources of a portion of the Missouri River valley in northeastern Nebraska, by G. E. Condra. 1908. 59 pp., 11 pls. 40c.

Describes topography, rock formation, mineral resources, streams, springs, shallow and artesian wells, soils, crops, and timber, in Boyd, Knox, Cedar, Dixon, and Dakota counties, and part of Holt County.

*216. Geology and water resources of the Republican River valley and adjacent areas, Nebraska, by G. E. Condra. 1907. 71 pp., 13 pls. 15c.

Describes topographic, drainage, temperature, rainfall, winds, rock systems, surface and underground waters, water powers, soils, crops, and timbers of Dundy, Hitchcock, Redwillow, Furnas, Harlan, Franklin, Webster, Nuckolls, Thayer, and Jefferson counties.

221. Geology and water resources of the Great Falls region, Montana, by C. A. Fisher. 1909. 89 pp., 7 pls. 20c.

Describes the topographic features, geologic-formation, streams, lakes, swamps, springs, and artesian wells of a portion of the Great Plains in Cascade, Teton, Fergus, Chouteau, and Lewis and Clark counties; discusses the chemical character of the waters (analyses), water powers, irrigation, temperature, rainfall, and agriculture, and gives details of water supplies by districts.

*227. Geology and underground waters of South Dakota, by N. H. Darton. 1909. 156 pp., 15 pls. 40c.

Describes physical features, geologic formations, water horizons, and, by counties, deep wells and well prospects; gives notes on construction and management of artesian wells.

*230. Surface water supply of Nebraska, by J. C. Stevens. 1909. 251 pp., 6 pls. 35c.

Discusses relation of rainfall to run-off and evaporation and seepage near Kearney; describes the river basins, and gives results of observations at gaging stations.

236. The quality of surface waters in the United States, Part I, Analyses of waters east of one hundredth meridian, by R. B. Dole. 1909. 123 pp. 10c.

Describes collection of samples, methods of examinations, preparation of solutions, accuracy of estimates, and expression of analytical results; gives results of analyses of waters of Missouri, North Platte, and Platte rivers.

*258. Underground-water papers, 1910, by M. L. Fuller, F. G. Clapp, G. C. Matson, Samuel Sanford, and H. C. Wolff. 1911. 123 pp., 2 pls. 15c.

Contains brief report entitled "The utilization of the underflow near St. Francis, Kans.," by H. C. Wolff; discusses the water-bearing material, velocity, amount, rate of movement, and quality of the waters; arrangement and method of sinking the wells selection and installation of pumps, engines and cost of pumping, storage reservoirs, and loss by evaporation.

273. Quality of the water supplies of Kansas, by H. N. Parker, with a preliminary report on stream pollution by mine waters in southeastern Kansas, by E. H. S. Bailey. 1911. 375 pp., 1 pl. 30c.

Describes the topographic and geologic features of the State and the artesian basins; discusses the significance of mineral constituents and classification of waters; gives details concerning quality of underground water by counties and surface water by drainage basins.

274. Some stream waters of the western United States, with chapters on sediment carried by the Rio Grande and the industrial application of water analyses, by Herman Stabler. 1911. 188 pp. 15c.

Describes collection of samples, plan of analytical work, and methods of analysis; discusses soap-consuming power of waters, water softening, boiler waters, and water for irrigation; gives results of analyses of samples of water from streams in Missouri River basin.

293. Underground water resources of Iowa, by W. H. Norton, W. S. Hendrixson, H. E. Simpson, O. E. Meinzer, and others. 1912. 994 pp., 18 pls. 70c.

Describes the relief, drainage, temperature, and precipitation of the State and the geologic formations; discusses the geologic occurrence of underground waters, artesian phenomena and yield of artesian wells, the chemical composition of underground waters, municipal, domestic, and industrial water supplies, and mineral waters; gives details concerning topography, geology, underground waters, and city and village supplies by districts and counties.

345. Contributions to the hydrology of the United States, 1914; N. C. Grover, chief hydraulic engineer. 1915. 225 pp., 17 pls. 30c. Contains:

*(*g*) The water resources of Butte, Mont., by O. E. Meinzer (pp. 79-125, pls. 7-8.)

364. Water analyses from the laboratory of the United States Geological Survey, tabulated by F. W. Clarke, chief chemist. 1914. 40 pp.

Contains analyses from spring and well waters from Missouri, Wyoming, Yellowstone National Park, Montana, and Colorado, and of mine waters from Butte, Mont.

367. Profile surveys of Missouri River from Great Falls to Three Forks, Montana, prepared under the direction of R. B. Marshall, chief geographer. 1914. 8 pp., 1 pl. (13 sheets). 50c.

Gives a brief description of the general features of the Missouri River basin, a list of the gaging stations that have been maintained between Three Forks and Great Falls, and of the publications containing the results of stream-flow measurements.

*425. Contributions to the hydrology of the United States, 1917; N. C. Grover, chief hydraulic engineer. 1918. Contains:

*(b) Ground water for irrigation in Lodgepole Valley, Wyo.-Nebr., by O. E. Meinzer (pp. 37-69, pls. 4-6). Describes the physiography and geology of Lodgepole Valley and the adjacent region and the water in the alluvial gravel and in the Tertiary and Cretaceous formations; discusses irrigation with ground water; gives well data and analyses of 20 wells waters and 2 samples from Lodgepole Creek; contains maps showing the geology and the depths to the water table; also includes data on the cost of pumping for irrigation in western Nebraska, by H. C. Diesem, U. S. Department of Agriculture.

428. Artesian water in the vicinity of the Black Hills, S. Dak., by N. H. Darton. 1918. 64 pp., 13 pls.

Describes the geology and artesian-water conditions in areas covered in previous reports but in the light of additional data. Discusses the artesian prospects of the Dakota, Minnelusa, and Deadwood sandstones. Contains a map showing the geology and the depths to the water-bearing sandstones.

ANNUAL REPORTS.

Each of the papers contained in the annual reports was also issued in separate form.

Annual reports are distributed free by the Geological Survey as long as its stock lasts. An asterisk (*) indicates that this stock has been exhausted. Many of the papers so marked, however, may be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C.

*Tenth Annual Report of the United States Geological Survey, 1888-89; J. W. Powell, Director. 1890. 2 parts. *Pt. II. Irrigation, viii, 123 pp. 35c.

Makes a preliminary report on the organization and prosecution of the survey of the arid lands for purposes of irrigation; includes an account of the methods of topographic and hydraulic work, the segregation work on reservoir sites and irrigable lands, field and office methods, and brief descriptions of the topography of some of the river basins.

Eleventh Annual Report of the United States Geological Survey, 1889-90; J. W. Powell, Director. 1891. 2 parts. Pt. II. Irrigation, xiv, 395 pp., 30 plates and maps. $1.25. Contains:

*Hydrography, pp. 1-110. Discusses scope of work, methods of stream measurements, rainfall, and evaporation, and describes the more important streams.

*Engineering, pp. 111-200. Defines the scope of the work and gives an account of the surveys in the Sun River basin and in the Arkansas, Rio Grande, California, Lahontan, Utah, and Snake River divisions.

*The arid lands, pp. 201-289. Includes statement of the Director to the House Committee on Irrigation, extracts from the constitutions of States relating to irrigation, and a report on artesian irrigation on the Great Plains, including a discussion of the general considerations affecting artesian water supply, the economic limit to the utilization of artesian water for irrigation, irrigation by artesian wells in various countries, and the geologic conditions and statistics of artesian wells on the Great Plains.

*Topography, pp. 291-343. Comprises reports of the topographic surveys in California, Nevada, Colorado, Idaho, Montana, and New Mexico, and a report on reservoir sites.

*Irrigation literature, pp. 345-388. Gives a list of books and pamphlets on irrigation and allied subjects, mainly contained in the library of the United States Geological Survey.

*Twelfth Annual Report of the United States Geological Survey, 1890-91; J. W. Powell, Director. 1891. 2 parts. *Pt. II. Irrigation, xviii, 576 pp., 93 pls. $2.00. Contains:

*Report upon the location and survey of reservoir sites during the fiscal year ended June 30, 1891, by A. H. Thompson, pp. 1-212, pls. 54-57. Describes reservoir sites in Meagher, Lewis and Clark, Beaverhead, Madison, Chouteau, Cascade, and Fergus counties, Mont., and for each site gives the location, brief description of the drainage basin, height of dam, capacity of reservoir, and the area of segregated land.

*Hydrography of the arid regions, by F. H. Newell, pp. 213-361, pls. 58-106. Discusses the available water supply of the arid regions, the duty of water, flood waters, relation of rainfall to river flow; classifies the drainage basins; and describes the rivers of the Missouri, Arkansas, Rio Grande, Colorado, Sacramento, and San Joaquin basins, and the principal streams of the Great Basin in Nevada and Utah and the Snake River basin.

Thirteenth Annual Report of the United States Geological Survey, 1891–92; J. W. Powell, Director. 1892. (Pts. II and III, 1893.) 3 parts. *Pt. III. Irrigation, xi, 486 pp., 77 pls. $1.85. Contains:

*Water supply for irrigation, by F. H. Newell, pp. 1–99, pls. 108–110. Discusses areas irrigated and irrigable, fluctuations in rivers and lakes, cost and value of water supply, and describes the location and area, topography, land classification, extent of irrigation, precipitation, and water measurements on the Missouri and its tributaries.

*Engineering results of irrigation survey, by H. M. Wilson, pp. 351–427, pls. 147–182. Describes the reservoirs, canal lines, areas of lands reclaimable, and estimated revenue from irrigation works on the Sun River system, Montana.

Sixteenth Annual Report of the United States Geological Survey, 1894–95; Charles D. Walcott, Director. 1896. (Pts. II, III, and IV, 1895.) 4 parts. *Pt. II. Papers of an economic character, xix, 598 pp., 42 pls. $1.25. Contains:

The public lands and their water supply, by F. H. Newell, pp. 457–533, pls. 35–39. Describes the general character of the public lands, the lands disposed of (railroad, grant, and swamp lands, and private, miscellaneous entries), lands reserved (Indian, forest, and military reservations), the vacant lands, and the rate of disposal of vacant lands; discusses the streams, wells, and reservoirs as sources of water supply; gives details for each State.

*Water resources of a portion of the Great Plains, by Robert Hay, pp. 535–588, pls. 40–42. Describes an area comprising between 5,000 and 6,000 square miles and including parts of three counties of Kansas, five counties of Nebraska, and six of Colorado, drained to the Missouri through Platte and Kansas rivers; discusses the lakes, streams, and springs of the area, the underflow of the river bottoms, and the water-bearing strata under the higher lands; treats also of the sources of the water supply, rainfall, rate of percolation, and volume; valley, upland, and deep wells; waterless wells, artesian flow, and blowing wells; and the temperature of the well waters; describes briefly the topography and geology of the region and the utilization of the water supply.

Seventeenth Annual Report of the United States Geological Survey, 1895–96; Charles D. Walcott, Director. 1896. 3 parts in 4 vols. *Pt. II. Economic geology and hydrography, xxv, 864 pp., 113 pls. $2.35. Contains:

Preliminary report on artesian waters of a portion of the Dakotas, by N. H. Darton, pp. 603–694, pls. 69–107. Gives an outline of the geologic relations; describes the water horizons and the extent of the artesian water, and gives details concerning wells and prospects by counties; discusses the origin, amount, pressure, head, and composition of the artesian water, the use of artesian water for power, and gives details concerning artesian irrigation by counties; contains also remarks on the construction and management of artesian wells.

Eighteenth Annual Report of the United States Geological Survey, 1896–97; Charles D. Walcott, Director. 1897. (Pts. II and III, 1898.) 5 parts in 6 vols. *Pt. IV. Hydrography, x, 756 pp., 102 pls. $1.75. Contains:

*New development in well boring and irrigation in eastern South Dakota, 1896, by N. H. Darton, pp. 561–615, pls. 38–47. Discusses progress in well sinking and irrigation by artesian waters in 1896 in Aurora, Beadle, Bonhomme, Brule, Buffalo, Charles Mix, Davison, Douglas Hanson, Hutchinson, Jerauld, Sanborn, Spink, and Yankton counties, South Dakota, and in areas west of the Missouri River; treats also of the temperature and volume of flow of the deeper artesian waters and gives chemical analyses of waters from Missouri River and from artesian wells in the Sanborn basin.

*Reservoirs for irrigation, by J. D. Schuyler, pp. 617–740, pls. 48–102. Describes reservoir sites on Goose Creek, Tarryall Creek, and South Fork of South Platte River in Colorado; gives tables of reservoir capacity and areas.

Nineteenth Annual Report of the United States Geological Survey, 1897–98; Charles D. Walcott, Director. 1898. (Pts. II, III, IV, and V, 1899.) 6 parts in 7 vols. and separate case for maps with Pt. V. *Pt. IV, Hydrography, viii, 814 pp., 118 pls. $1.85. Contains:

*Preliminary report on the geology and water resources of Nebraska west of the one hundred and third meridian, by N. H. Darton, pp. 719–785, pls. 74–118. Describes topography and drainage of the area, the general geology of Nebraska, and the geology of the area covered by the report; the water horizons, and deep-seated waters; discusses springs, streams, irrigation, climate, and timber, and gives list of elevations.

——— *Pt. V, Forest reserves, pp. xvii–400, 110 pls. (16 maps in separate case, paper, 75c.; cloth, $1.00.) $1.25. Contains:

*Black Hills Forest Reserve, by H. S. Graves, pp. 67–164, pls. 14–36.
*Big Horn Forest Reserve, by F. E. Town, pp. 165–190, pls. 37–42.
Yellowstone Park Forest Reserve, southern part, from notes by T. S. Brandegee, pp. 213–216.
These reports contain many descriptions of the streams of the forest reserves.

Twentieth Annual Report of the United States Geological Survey, 1898–99; Charles D. Walcott, Director. 1899. (Pts. II, III, IV, V, and VII, 1900.) 7 parts in 8 vols. and separate case for maps with Pt. V. *Pt. V, Forest reserves, xix, 498 pp., 159 pl., 8 maps in separate case. $2.80. Contains:

*Pikes Peak, Plum Creek, and South Platte reserves, by J. G. Jack, pp. 39–115, pls. 8–47. Describes briefly the drainage of the forest reserves.

Twenty-first Annual Report of the United States Geological Survey, 1899–1900; Charles D. Walcott, Director. 1900. (Pts. III, IV, VI, VI continued, and VII, 1901.) 7 parts in 8 vols., and separate case for maps with Pt. V. *Pt. IV, Hydrography, 768 pp., 156 pls. $2.25. Contains:

*Preliminary description of the geology and water resources of the southern half of the Black Hills and adjoining regions in South Dakota and Wyoming, by N. H. Darton, pp. 489–599, pls. 58–112. Describes the topography and geology of an area comprisong about 5,500 square miles in southwestern corner of South Dakota, and the adjoining portion of Wyoming. Discusses the geologic formations and their contained waters, the deep borings at Edgemont and other places, the surface waters (Cheyenne and Fall River, Beaver, Lame Johnny, French, Battle Spring, Hat, Cascade, Stockade Beaver, and Beaver Creeks), and irrigation, the soils, mineral resources, climate, temperature, and timber.

*The High Plains and their utilization, by W. D. Johnson, pp. 601–741, pls. 113–146. Describes the area lying in an irregular belt about midway across the long eastward slope of the Great Plains and including parts of Wyoming, Colorado, Nebraska, Kansas, New Mexico, Oklahoma, and Texas; discusses the origin and structure of the High Plains, the precipitation, temperature, and other factors of climate, experiments with irrigation, and the use of mountain streams, local storm-water storage, and artesian waters. Concluded in the Twenty-second Annual Report, Pt. IV, pp. 631–669, pls. 51–65.

——— *Pt. V, Forest reserves, 711 pp., 143 pls., 39 maps in separate case. $3.85. Contains:

*Lewis and Clarke Forest Reserve, Mont., by H. B. Ayres, pp. 27–80, pls. 2–32. Briefly describes the valleys of the streams.

BULLETINS.

An asterisk (*) indicates that the Geological Survey's stock of the paper is exhausted. Many of the papers so marked may be purchased from the Superintendent of Documents, Washington, D. C.

*47. Analyses of waters of the Yellowstone National Park, with an account of the methods of analysis employed, by F. A. Gooch and J. E. Whitfield. 1888. 84 pp.

Describes methods used in analyzing natural waters and contains analyses of 43 geyser, spring, and surface waters in Yellowstone National Park.

*264. Record of deep-well drilling for 1904, by M. L. Fuller, E. F. Lines, and A. C. Veatch. 1905. 106 pp. 10c.

Discusses the importance of accurate well records to the driller, to owners of oil, gas, and water wells, and to the geologist; describes the general methods of work; gives tabulated records of wells in Kansas and Missouri, and detailed records of wells in Greeley County, Kansas, and Randolph County, Missouri. These wells were selected because they give definite stratigraphic information.

265. Geology of the Boulder district, Colo., by N. M. Fenneman. 1905. 101 pp., 5 pls. 15c.

Describes the geology of a rectangular area 16 miles north and south by 9 miles east and west, in the southwestern part of which is situated the city of Boulder. Discusses briefly (pp. 67–69) the flowing wells and water-bearing formations, including the Dakota sandstone. Contains a geologic map of the area.

*298. Record of deep-well drilling for 1905, by M. L. Fuller and Samuel Sanford. 1906. 299 pp. 25c.

Gives an account of progress in the collection of well records and samples; contains tabulated records of wells in Colorado, Iowa, Kansas, Minnesota, Missouri, Montana, Nebraska, North Dakota, South Dakota, and Wyoming, and detailed records of wells in Geary and Wyandotte counties, Kansas; Jackson County, Missouri; Teton County, Montana; and Beadle and Miner counties, South Dakota. The wells of which detailed sections are given were selected because they afford valuable stratigraphic information.

*364. Geology and mineral resources of the Laramie basin, Wyo. (a preliminary report, by N. H. Darton and C. E. Siebenthal. 1909. 81 pp., 8 pls. 20c.

Describes the geology and contains a geologic map. Includes a section on ground water (pp. 67–78), in which are given well data and 6 water analyses. A part of the area is covered by Geologic Folio 173, which also contains information on ground water.

*395. Radioactivity of the thremal waters of Yellowstone National Park, by Herman Schlundt and R. B. Moore. 1909. 35 pp., 4 pls. 10c.

Describes the apparatus and methods used and presents and discusses the results of the experiments.

*471. Contributions to economic geology, 1910, Part II, Mineral fuels; M. R. Campbell, geologist in charge. 1912. 663 pp., 62 pls. $1.05.

Issued also in separate chapters. The following paper contains information on ground water:

*(a) The Powder River oil field, Wyo., by C. H. Wegemann (pp. 56–75). Describes the geology and contains a geologic map of a quadrangular area which includes Tps. 40–42 N., R. 81 W., and portions of adjoining townships. Contains brief notes on water supplies, including water-bearing formations (pp. 59, 59).

*575. Geology of the Standing Rock and Cheyenne River Indian reservations, North and South Dakota, by W. R. Calvert, A. L. Beekly, V. H. Barnett, and M. A. Pishel. 1914. 49 pp., 8 pls. 15c.

Covers an area lying west of Missouri River, north of Cheyenne River, and south of Cannonball River, and extending westward to 102d meridian. Describes the geology and contains a geologic map of the area. Includes a brief discussion of the water in the Dakota and Fox hills sandstones and in other formations (pp. 24–25).

*621. Contributions to economic geology, 1915, Part II, Mineral fuels; M. R. Campbell and David White, geologists in charge. 1916. 375 pp., 25 pls. 60c.

Issued also in separate chapters. The following chapter contains information on ground water:

*(l) Oil and gas near Basin, Big Horn County, Wyo., by C. T. Lupton (pp. 157–190, Pl. XVII), describes the geology and contains a geologic map of parts of Tps. 50–52 N., Rs. 92 and 93 W. Includes a brief description of the water supplies and of the water-bearing sand with a table giving percentages of oil and gas wells that obtained water in each of these sand strata (pp. 164–166) It also includes well records that contain some data in regard to water (pp. 186–189).

627. The lignite field of northwestern South Dakota, by D. E. Winchester, C. J. Hares, E. R. Lloyd, and E. M. Parks. 1916. 169 pp., 11 pls. 25c.

Describes the geology and contains geologic maps of Harding and Perkins counties. Describes the drainage and water supply and contains a small amount of data on deep well not given in Water-Supply Paper 227.

*641. Contributions to economic geology, 1916, Part II, Mineral fuels; David White, G. H. Ashley, and M. R. Campbell, geologists in charge.

Issued also in separate chapters. The following chapter contains information on ground water:

*(i) Anticlines in central Wyoming, by C. J. Hares (pp. 233–280, Pl. XVIII). Covers nearly 5,000 square miles in Natrona and Fremont counties, west of Casper and southeast of Lander. Contains, on pages 235 and 236, a brief discussion of the water supply, including statements regarding various hot springs, springs of large size, sulphur springs, and other mineral springs; also a statement regarding water-bearing formations and artesian prospects. Includes a geologic map.

647. The Bull Mountain coal fields, Musselshell and Yellowstone counties, Mont.; by L. H. Woolsey, R. W. Richards, and C. T. Lupton. 1917. 218 pp., 36 pls.

Gives detailed data regarding water supplies, including ground water, for the following townships: Tps. 5–8 N., R. 24 E.; Tps. 5–8 N., R. 25 E.; Tps. 5–8 N., R. 26 E.; Tps. 5–9 N., R. 27 E.; Tps. 5–9 N., R. 28 E.; Tps. 5–9 N., R. 29 E.; Tps. 5–9 N., R. 30 E.; Tps. 5–9 N., R.. 31 E.; T. 8 N., R. 32 E.

656. Anticlines in the southern part of the Big Horn Basin, Wyo., a preliminary report on the occurrence of oil, by D. F. Hewett and C. T. Lupton. 1917. 192 pp., 32 pls. 35c.

Covers a large region in northwestern Wyoming, west of the Big Horn Mountains. Gives detailed data regarding surface waters, springs, wells, and ground-water prospects in the numerous anticlinal areas described in the report. See pages 15, 16, 56–188. Includes a geologic map and section.

PROFESSIONAL PAPERS.

Professional papers are distributed free by the Geological Survey as long as its stock lasts. An asterisk (*) indicates that this stock has been exhausted. Many of the papers marked with an asterisk may, however, be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C. Professional papers are of quarto size.

*17. Preliminary report on the geology and water resources of Nebraska west of the one hundred and third meridian, by N. H. Darton. 1903. 69 pp., 43 pls. 50c.

Describes topography and general geology of Nebraska, the streams, springs, and deep-seated waters, and irrigation; gives list of elevations.

*32. Preliminary report on the geology and underground water resources of the central Great Plains, by N. H. Darton. 1905. 433 pp., 72 pls. $1.80.

Describes topography, drainage, stratigraphy, historical geology, and the water horizons; discusses deep wells and prospects (by counties and towns) in South Dakota (see Water-Supply Paper 227), Nebraska, central and western Kansas, eastern Colorado, and eastern Wyoming; discusses also the occurrence of coal, petroleum, and natural gas, salt, gypsum, gold, iron ore, and other minerals.

*53. Geology and water resources of the Big Horn basin, Wyoming, by C. A. Fisher. 1906. 72 pp., 16 pls.

Describes the topography of the region, the stratigraphic, structural, and historical geology, and the underground waters, coal, oil, and gas, building stone, and other mineral resources; discusses briefly irrigation and mineral waters.

*65. Geology and water resources of the northern portion of the Black Hills and adjoining regions in South Dakota and Wyoming, by N. H. Darton. 1909. 105 pp., 24 pls. 40c.

Describes the topography of the region and the stratigraphic, structural, and historical geology of the sedimentary rocks; discusses their mineral resources, including underground water, coal, gypsum, etc.; contains also information concerning the surface waters.

MONOGRAPHS.

Monographs are of quarto size. They are not distributed free, but may be obtained from the Geological Survey or from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C., at the prices indicated. An asterisk (*) indicates that the Survey's stock of the paper is exhausted.

25. The glacial Lake Agassiz, by Warren Upham. 1896. 658 pp., 38 pls. $1.70.

Contains a chapter (pp. 523–582) on "Artesian and common wells of the Red River Valley," which discusses the sources of artesian water, the fresh waters in the drift sheets, the saline and alkaline waters in the Dakota sandstone, and the use of artesian water for irrigation; contains analyses of waters from wells, streams, and lakes in Red River Valley and the adjoining region; and gives notes on wells in Clay, Kittson, Marshall, Norman, Polk, Traverse, and Wilkin counties, in Minnesota; in Cass, Grand Forks, Pembina, Richland, Traill, and Walsh counties, in North Dakota; and in a part of the area covered by Lake Agassiz, in Manitoba. The monograph includes numerous maps relating to the Pleistocene geology of the region and a map (Pl. XXXVII) showing the distribution and depths of artesian wells in glacial drift and bedrock.

*27. Geology of the Denver Basin in Colorado, by S. F. Emmons, Whitman Cross, and G. H. Eldridge. 1896. 556 pp., 31 pls. $1.50.

Contains a discussion of the water in the Pleistocene deposits (pp. 272, 273) and a section on artesian wells (pp. 401–465). Discusses the history of artesian-water developments in Colorado, the water-bearing horizons, the artesian structure, the quantity of artesian water, and the yield and decrease in yield of flowing wells. Includes three analyses of well waters and maps showing the geology of the region and the original area of artesian flow.

GEOLOGIC FOLIOS.

Under the plan adopted for the preparation of a geologic map of the United States the entire area is divided into small quadrangles, bounded by certain meridians and parallels, and these quadrangles, which number several thousand, are separately surveyed and mapped.[1] The unit of survey is also the unit of publication, and the maps and description of each quadrangle are issued in the form of a folio. When all the folios are completed they will constitute the Geologic Atlas of the United States.

A folio is designated by the name of the principal town or of a prominent natural feature within the quadrangle. Each folio includes maps showing the topography, geology, underground structure, and mineral deposits of the area mapped and several pages of descriptive text. The text explains the maps and describes the topographic and geologic features of the country and its mineral products. The topographic map shows roads, railroads, waterways, and, by contour lines, the shapes of the hills and valleys and the height above sea level of all points in the quadrangle. The areal-geology map shows the distribution of the various rocks at the surface. The structural-geology map shows the relations of the rocks to one another underground. The economic-geology map indicates the location of mineral deposits that are commercially valuable. The artesian-water map shows the depth to underground-water horizons. Economic-geology and artesian-water maps are included in folios if the conditions in the areas mapped warrant their publication. The folios are of special interest to students of geography and geology and are valuable as guides in the development and utilization of mineral resources.

The folios numbered from 1 to 163, inclusive, are published in only one form (18 by 22 inches), called the library edition. Some of the folios that bear numbers higher than 163 are published also in an octavo edition (6 by 9 inches). Owing to a fire in the Geological Survey building May 18, 1913, the stock of geologic folios was more or less damaged by fire and water, but 80 or 90 per cent of the folios are usable. They will be sold at the uniform price of 5 cents each, with no reduction for wholesale orders. This rate applies to folios in stock from 1 to 184, inclusive (except reprints), also to the library edition of folio 186. The library edition of folios 185, 187, and higher numbers sells for 25 cents a copy, except that some folios which contain an unusually large amount of matter sell at higher prices. The octavo edition of folio 185 and higher numbers sells for 50 cents a copy, except folio 193, which sells for 75 cents a copy. A discount of 40 per cent is allowed on an order for folios or for folios togerher with topographic maps amounting to $5 or more at the retail rate.

All the folios contain descriptions of the drainage of the quadrangles. The folios in the following list contain also brief discussions of the underground waters in connection with the economic resources of the areas and more or less information concerning the utilization of the water resources.

*24. Three Forks, Montana.
*55. Fort Benton, Montana.
*56. Little Belt Mountains, Montana.
85. Oelrichs, South Dakota–Nebraska. 5c.
87. Camp Clark, Nebraska. 5c.
88. Scotts Bluff, Nebraska. 5c.
96. Olivet, South Dakota. 5c.
97. Parker, South Dakota. 5c.
99. Mitchell, South Dakota. 5c.
100. Alexandria, South Dakota. 5c.
*107. Newcastle, Wyoming–South Dakota. 5c.
108. Edgemont, South Dakota–Nebraska. 5c.
113. Huron, South Dakota. 5c.
114. De Smet, South Dakota. 5c.
117. Castleton-Fargo, North Dakota–Minnesota. 5c.

[1] Index maps showing areas in the Missouri River basin covered by typographic maps and by geologic folios will be mailed on receipt of request addressed to the Director, U. S. Geological Survey, Washington, D. C.

*127. Sundance, Wyoming-South Dakota.
*128. Aladdin, Wyoming-South Dakota-Montana. 5c.
*141. Bald Mountain-Dayton, Wyoming. 5c.
*142. Cloud Peak-Fort McKinney, Wyoming. 5c.
*150. Devils Tower, Wyoming.
156. Elk Point, South Dakota-Nebraska-Iowa. 5c.
165. Aberdeen-Redfield[1] (Northville, Aberdeen, Redfield, and Byron quadrangles), South Dakota. 5c.
168. Jamestown-Tower[1] (Jamestown, Eckleson, and Tower quadrangles), North Dakota. 5c.
181. Bismarck,[1] North Dakota. 5c.
196. Philipsburg, Montana. 25c.
206. Leavenworth, Smithville, Missouri-Kansas. 25c.

MISCELLANEOUS REPORTS.

Other Federal bureaus and State and other organizations have from time to time published reports relating to the water resources of the various sections of the country. Notable among those pertaining to the Missouri River basin are the reports of the Chief of Engineers, United States Army, of the State geologist of Kansas, the State Drainage Commission of Minnesota, the Commission on Conservation of the State of Montana, the State Board of Irrigation of Nebraska, the superintendent of the Department of Irrigation, Forestry, Fish, and Game of North Dakota, and the State Engineer of Wyoming. The following reports deserve special mention:

The Missouri River and its utmost source, by J. V. Brower. St. Paul, 1896.

Geological report of the exploration of the Yellowstone and Missouri rivers, by F. V. Hayden. Washington, 1869.

Preliminary examination of reservoir sites in Wyoming and Colorado: 55th Cong., 2d session, House Doc. 141.

Report of the Commission appointed by his excellency the governor of the State of Colorado to revise the laws of the State [of Colorado] regulating the appropriation, distribution, and use of water. Denver, 1890.

Some aspects of irrigation development in Colorado, by G. G. Anderson; Colorado Sci. Soc. Proc., vol. 9, 1909.

Special report on well waters in Kansas, by Erasmus Haworth; Kansas Univ. Geol. Survey Bull. 1.

Report of Board of Irrigation Survey and Experiment [Kansas] for 1895–96. Topeka, 1897.

Water supplies of Kansas, by C. A. Haskins and C. C. Young; Univ. of Kansas Bull. 5, vol. 16, 1915.

Report of the commission on conservation [State of Montana] on bills relating to public lands, water rights, and the protection and preservation of the forests. Helena, 1911.

Irrigation laws of the State of Wyoming; compiled in the office of the State engineer.

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[1] Issued in two editions—library and octavo. Specify edition desired.

GEOLOGICAL SURVEY HYDROLOGIC REPORTS OF GENERAL INTEREST.

The following list comprises reports which are not readily classifiable by drainage basins and which cover a wide range of hydrologic investigations:

WATER-SUPPLY PAPERS.

*1. Pumping water for irrigation, by H. M. Wilson. 1896. 57 pp., 9 pls.

Describes pumps and motive powers, windmills, water wheels, and various kinds of engines; also storage reservoirs to retain pumped water until needed for irrigation.

*3. Sewage irrigation, by G. W. Rafter. 1897. 100 pp., 4 pls. (See Water-Supply Paper 22.) 10c.

Discusses methods of sewage disposal by intermittent filtration and by irrigation; describes utilization of sewage in Germany, England, and France, and sewage purification in the United States.

*8. Windmills for irrigation, by E. C. Murphy. 1897. 49 pp., 8 pls. 10c.

Gives results of experimental tests of windmills during the summer of 1896 in the vicinity of Garden, Kans.; describes instruments and methods and draws conclusions.

*14. New tests of certain pumps and water lifts used in irrigation, by O. P. Hood. 1898. 91 pp., 1 pl. 10c.

Discusses efficiency of pumps and water lifts of various types.

*20. Experiments with windmills, by T. O. Perry. 1899. 97 pp., 12 pls. 15c.

Includes tables and descriptions of wind wheels, makes comparisons of wheels of several types, and discusses results.

*22. Sewage irrigation, Part II, by G. W. Rafter. 1899. 100 pp., 7 pls. 15c.

Gives résumé of Water-Supply Paper No. 3; discusses pollution of certain streams, experiments on purification of factory wastes in Massachusetts, value of commercial fertilizers, and describes American sewage-disposal plants by States; contains bibliography of publications relating to sewage utilization and disposal.

*41. The windmill, its efficiency and economic use, Part I, by E. C. Murphy. 1901. 72 pp., 14 pls.

*42. The windmill, its efficiency and economic use, Part II, by E. C. Murphy. 1901. 75 pp., 2 pls. 10c.

Nos. 41 and 42 give details of results of experimental tests with windmills of various types.

*43. Conveyance of water in irrigation canals, flumes, and pipes, by Samuel Fortier. 1901. 86 pp., 15 pls. 15c.

*56. Methods of stream measurements. 1901. 51 pp., 12 pls. 15c.

Describes the methods used by the Survey in 1901-2. (See also Nos. 64, 94, and 95.)

*64. Accuracy of stream measurements, by E. C. Murphy. 1902. 99 pp., 4 pls. (See No. 95.) 10c.

Describes methods of measuring velocity of water and of measuring and computing stream flow, and compares results obtained with the different instruments and methods; describes also experiments and results at the Cornell University hydraulic laboratory. A second, enlarged, edition published as Water-Supply Paper 95.

*67. The motions of underground waters, by C. S. Slichter. 1902. 106 pp., 8 pls. 15c.

Discusses origin, depth, and amount of underground waters; permeability of rocks and porosity of soils; causes, rates, and laws of motions of underground water; surface and deep zones of flow, and recovery of waters by open wells and artesian and deep wells; treats of the shape and position of the water table; gives simple methods of measuring yield of flowing wells; describes artesian wells at Savannah, Ga.

72. Sewage pollution in the metropolitan area near New York City and its effect on inland water resources, by M. O. Leighton. 1902. 75 pp., 8 pls. 10c.

Defines "normal" and "polluted" waters and discusses the damage resulting from pollution.

*80. The relation of rainfall to run-off, by G. W. Rafter. 1903. 104 pp. 10c.

Treats of measurements of rainfall and laws of measurements of stream flow; gives formulas for rainfall, run-off, and evaporation; discusses effect of forests on rainfall and run-off.

87. Irrigation in India (second edition), by H. M. Wilson. 1903. 238 pp., 27 pls. 25c.

First edition was published in Part II of the Twelfth Annual Report.

93. Proceedings of first conference of engineers of the Reclamation Service, with accompanying papers, compiled by F. H. Newell, chief engineer. 1904. 361 pp. 25c.

Contains, in addition to an account of the organization of the hydrographic [water-resources] branch of the United States Geological Survey, and the report of the conference, the following papers of more or less general interest:

Limits of an irrigation project, by D. W. Ross.
Relation of Federal and State laws to irrigation, by Morris Bien.
Electrical transmission of power for pumping, by H. A. Storrs.
Correct design and stability of high masonry dams, by Geo. Y. Wisner.
Irrigation surveys and the use of the plane table, by J. B. Lippincott.
The use of alkaline waters for irrigation, by Thomas H. Means.

*94. Hydrographic manual of the United States Geological Survey, prepared by E. C. Murphy, J. C. Hoyt, and G. B. Hollister. 1904. 76 pp., 3 pls. 10c.

Gives instruction for field and office work relating to measurements of stream flow by current meters. (See also No. 95.)

*95. Accuracy of stream measurements (second, enlarged, edition), by E. C. Murphy. 1904. 169 pp., 6 pls.

Describes methods of measuring and computing stream flow and compares results derived from different instruments and methods. (See also No. 94.)

*103. A review of the laws forbidding pollution of inland waters in the United States, by E. B. Goodell. 1904. 120 pp. (See No. 152.)

Explains the legal principles under which antipollution statutes become operative, quotes court decisions to show authority for various deductions, and classifies according to scope the statutes enacted in the different States.

*110. Contributions to the hydrology of eastern United States, 1904; M. L. Fuller, geologist in charge. 1905. 211 pp., 5 pls. 10c.

Contains the following reports of general interest. The scope of each paper is indicated by its title.

Description of underflow meter used in measuring the velocity and direction of underground water, by Charles S. Slichter.
The California or "stovepipe" method of well construction, by Charles S. Slichter.
Approximate methods of measuring the yield of flowing wells, by Charles S. Slichter.
Corrections necessary in accurate determinations of flow from vertical well casings, from notes furnished by A. N. Talbot.
Experiment relating to problems of well contamination at Quitman, Ga., by S. W. McCallie.

113. The disposal of strawboard and oil-well wastes, by R. L. Sackett and Isaiah Bowman. 1905. 52 pp., 4 pls. 5c.

The first paper discusses the pollution of streams by sewage and by trade wastes, describes the manufacture of strawboard, and gives results of various experiments in disposing of the waste. The second paper describes briefly the topography, drainage, and geology of the region about Marion, Ind., and the contamination of rock wells and of streams by waste oil and brine.

*114. Underground waters of eastern United States; M. L. Fuller, geologist in charge. 1905. 285 pp., 18 pls. 25c.

Contains report on "Occurrence of underground waters," by M. L. Fuller, discussing sources, amount, and temperature of waters, permeability and storage capacity of rocks, water-bearing formations, recovery of water by springs, wells, and pumps, essential condition of artesian flows, and general conditions affecting underground waters in eastern United States.

119. Index to the hydrographic progress reports of the United States Geological Survey, 1888 to 1903, by J. C. Hoyt and B. D. Wood. 1905. 253 pp. 15c.

Scope indicated by title.

120. Bibliographic review and index of papers relating to underground waters published by the United States Geological Survey, 1879–1904, by M. L. Fuller. 1905. 128 pp. 10c.

Scope indicated by title.

*122. Relation of the law to underground waters, by D. W. Johnson. 1905. 55 pp. 5c.

Defines and classifies underground waters, gives common-law rules relating to their use, and cites State legislative acts affecting them.

140. Field measurements of the rate of movement of underground waters, by C. S. Slichter. 1905. 122 pp., 15 pls. 15c.

Discusses the capacity of sand to transmit water, describes measurements of underflow in Rio Hondo, San Gabriel, and Mohave River valleys, Calif., and on Long Island, N. Y., gives results of tests of wells and pumping plants, and describes stovepipe method of well construction.

143. Experiments on steel-concrete pipes on a working scale, by J. H. Quinton. 1905. 61 pp., 4 pls.

Scope indicated by title.

145. Contributions to the hydrology of eastern United States, 1905; M. L. Fuller, geologist in charge. 1905. 220 pp., 6 pls. 10c.

Contains brief reports of general interest as follows:

Drainage of ponds into drilled wells, by Robert E. Horton. Discusses efficiency, cost, and capacity of drainage wells, and gives statistics of such wells in southern Michigan.

Construction of so-called fountain and geyser springs, by Myron L. Fuller.

A convenient gage for determining low artesian heads, by Myron L. Fuller.

146. Proceedings of second conference of engineers of the Reclamation Service, with accompanying papers, compiled by F. H. Newell, chief engineer. 1905. 267 pp. 15c.

Contains brief account of the organization of the hydrographic [water-resources] branch and the Reclamation Service, reports of conferences and committees, circulars of instruction, and many brief reports on subjects closely related to reclamation, and a bibliography of technical papers by members of the service. Of the papers read at the conference those listed below (scope indicated by title) are of more or less general interest.

Proposed State code of water laws, by Morris Bien.
Power engineering applied to irrigation problems, by O. H. Ensign.
Estimates on tunneling in irrigation projects, by A. L. Fellows.
Collection of stream-gaging data, by N. C. Grover.
Diamond-drill methods, by G. A. Hammond.
Mean-velocity and area curves, by F. W. Hanna.
Importance of general hydrographic data concerning basins of streams gaged, by R. E. Horton.
Effect of aquatic vegetation on stream flow, by R. E. Horton.
Sanitary regulations governing construction camps, by M. O. Leighton.
Necessity of draining irrigated land, by Thos. H. Means.
Alkali soils, by Thos. H. Means.
Cost of stream-gaging work, by E. C. Murphy.
Equipment of a cable gaging station, by E. C. Murphy.
Silting of reservoirs, by W. M. Reed.
Farm-unit classification, by D. W. Ross.
Cost of power for pumping irrigating water, by H. A. Storrs.
Record of flow at current-meter gaging stations during the frozen season, by F. H. Tillinghast.

147. Destructive floods in United States in 1904, by E. C. Murphy and others. 1905. 206 pp., 18 pls. 15c.

Contains a brief account of "A method of computing cross-section area of waterways," including formulas for maximum discharge and area of cross section.

*150. Weir experiments, coefficients, and formulas, by R. E. Horton. 1906. 189 pp., 38 pls. (See Water-Supply Paper 200.) 15c.

Scope indicated by title.

151. Field assay of water, by M. O. Leighton. 1905. 77 pp., 4 pls. 10c.

Discusses methods, instruments, and reagents used in determining turbidity, color, iron chlorides, and hardness in connection with the studies of the quality of water in various parts of the United States.

*152. A review of the laws forbidding pollution of inland waters in the United States (second edition), by E. B. Goodell. 1905. 149 pp. 10c.

Scope indicated by title.

*160. Underground water papers, 1906; M. L. Fuller, geologist in charge. 1906. 104 pp., 1 pl.

Gives account of work in 1905; lists of publications relating to underground waters, and contains the following brief reports of general interest.

Significance of the term "artesian," by Myron L. Fuller.
Representation of wells and springs on maps, by Myron L. Fuller.
Total amount of free water in the earth's crust, by Myron L. Fuller.
Use of fluorescein in the study of underground waters, by R. B. Dole.
Problems of water contamination, by Isaiah Bowman.
Instances of improvement of water in wells, by Myron L. Fuller.

*162. Destructive floods in the United States in 1905, with a discussion of flood discharge and frequency and an index to flood literature, by E. C. Murphy and others. 1906. 105 pp., 4 pls. 15c.

*163. Bibliographic review and index of underground-water literature published in the United States in 1905, by M. L. Fuller, F. G. Clapp, and B. L. Johnson. 1906. 130 pp. 15c.

Scope indicated by title.

*179. Prevention of stream pollution by distillery refuse, based on investigations at Lynchburg, Ohio, by Herman Stabler. 1906. 34 pp., 1 pl. 10c.

Describes grain distillation, treatment of slop, sources, character, and effects of effluents on streams; discusses filtration, precipitation, fermentation, and evaporation methods of disposal of wastes without pollution.

*180. Turbine water-wheel tests and power tables, by R. E. Horton. 1906. 134 pp., 2 pls. 20c.

Scope indicated by title.

*185. Investigations on the purification of Boston sewage, * * * with a history of the sewage-disposal problem, by C.-E. E. Winslow and E. B. Phelps. 1906. 163 pp. 25c.

Discusses composition, disposal, purification, and treatment of sewages and recent tendencies in sewage-disposal practice in England, Germany, and the United States; describes character of crude sewage at Boston, removal of suspended matter, treatment in septic tanks, and purification by intermittent sand filtration and in beds of coarse material; gives bibliography.

*186. Stream pollution by acid-iron wastes, a report based on investigations made at Shelby, Ohio, by Herman Stabler. 1906. 36 pp., 1 pl.

Gives history of pollution by acid-iron wastes at Shelby, Ohio, and resulting litigation; discusses effect of acid-iron liquors on sewage-purification processes, recovery of copperas from acid-iron wastes, and other processes for removal of pickling liquor.

*187. Determination of stream flow during the frozen season, by H. K. Barrows and R. E. Horton. 1907. 93 pp., 1 pl. 15c.

Scope indicated by title.

*189. The prevention of stream pollution by strawboard waste, by E. B. Phelps. 1906. 29 pp., 2 pls. 5c.

Describes manufacture of strawboard, present and proposed methods of disposal of waste liquors, laboratory investigations of precipitation and sedimentation, and field studies of amounts and character of water used, raw material and finished product, and mechanical filtration.

*194. Pollution of Illinois and Mississippi rivers by Chicago sewage (a digest of the testimony taken in the case of the State of Missouri *v.* the State of Illinois and the Sanitary District of Chicago), by M. O. Leighton. 1907. 369 pp., 2 pls. 40c.

Scope indicated by amplification of title.

*200. Weir experiments, coefficients, and formulas, revision of paper No. 150, by R. E. Horton. 1907. 195 pp., 38 pls. 35c.

Scope indicated by title.

*226. The pollution of streams by sulphite-pulp waste, a study of possible remedies, by E. B. Phelps. 1909. 37 pp., 1 pl. 10c.

Describes manufacture of sulphite pulp, the waste liquors, and the experimental work leading to suggestions as to methods of preventing stream pollution.

*229. The disinfection of sewage and sewage filter effluents, with a chapter on the putrescibility and stability of sewage effluents, by E. B. Phelps. 1909. 91 pp., 1 pl. 15c.

Scope indicated by title.

*234. Papers on the conservation of water resources. 1909. 96 pp., 2 pls. 15c.

Contains the following papers, whose scope is indicated by their titles: Distribution of rainfall by Henry Gannett; Floods, by M. O. Leighton; Developed water powers, compiled under the direction of W. M. Steuart, with discussion by M. O. Leighton; Undeveloped water powers, by M. O. Leighton; Irrigation, by F. H. Newell; Underground waters, by W. C. Mendenhall; Denudation, by R. B. Dole and Herman Stabler; Control of catchment areas, by H. N. Parker.

*235. The purification of some textile and other factory wastes, by Herman Stabler and G. H. Pratt. 1909. 76 pp. 10c.

Discusses waste waters from wool scouring, bleaching and dyeing cotton yarn, bleaching cotton piece goods, and manufacture of oleomargarine, fertilizer, and glue.

236. The quality of surface waters in the United States, Part I, Analyses of waters east of the one-hundredth meridian, by R. B. Dole. 1909. 123 pp. 10c.

Describes collection of samples, methods of examination, preparation of solutions, accuracy of estimates, and expression of analytical results.

238. The public utility of water powers and their governmental regulation, by René Tavernier and M. O. Leighton. 1910. 161 pp. 15c.

Discusses hydraulic power and irrigation, French, Italian, and Swiss legislation relative to the development of water powers, and laws proposed in the French Parliament; reviews work of bureau of hydraulics and agricultural improvement of the French department of agriculture and gives résumé of Federal and State water-power legislation in the United States.

*255. Underground waters for farm use, by M. L. Fuller. 1910. 58 pp., 17 pls. 15c.

Discusses rocks as sources of water supply and the relative safety of supplies from different materials; springs, and their protection; open or dug deep wells, their location, yield, relative cost, protection, and safety; advantages and disadvantages of cisterns and combination wells and cisterns.

*257. Well-drilling methods, by Isaiah Bowman. 1911. 139 pp., 4 pls. 15c.

Discusses amount, distribution, and disposal of rainfall, water-bearing rocks, amount of underground water, artesian conditions, and oil and gas bearing formations; gives history of wel drilling in Asia, Europe, and the United States; describes in detail the various methods and the machinery used; discusses loss of tools and geologic difficulties; contamination of well waters and methods of prevention; tests of capacity and measurement of depth; and cost of sinking wells.

*258. Underground-water papers, 1910, by M. L. Fuller, F. G. Clapp, G. C. Matson, Samuel Sanford, and H. C. Wolff. 1911. 123 pp., 2 pls. 15c.

Contains the following papers (scope indicated by titles) of general interest:
Drainage by wells, by M. L. Fuller.
Freezing of wells and related phenomena, by M. L. Fuller.
Pollution of underground waters in limestone, by G. C. Matson.
Protection of shallow wells in sandy deposits, by M. L. Fuller.
Magnetic wells, by M. L. Fuller.

274. Some stream waters of the western United States, with chapters on sediment carried by the Rio Grande and the industrial application of water analyses, by Herman Stabler. 1911. 188 pp. 15c.

Describes collection of samples, plan of analytical work and methods of analyses; discusses soap-consuming power of waters, water softening, boiler waters, and water for irrigation; gives results of analyses of waters of the Rio Grande and of Pecos, Gallinas, and Hondo rivers.

*315. The purification of public water supplies, by G. A. Johnson. 1913. 84 pp., 8 pls. 10c.

Discusses ground, lake, and river waters as public supplies, development of waterworks systems in the United States, water consumption, and typhoid fever; describes methods of filtration and sterilization of water, and municipal water softening.

334. The Ohio Valley flood of March-April, 1913 (including comparisons with some earlier floods), by A. H. Horton and H. J. Jackson. 1913. 96 pp., 22 pls. 20c.

Although relating specifically to floods in the Ohio Valley, this report discusses also the causes of floods and the prevention of damage by floods.

337. The effects of ice on stream flow, by William Glenn Hoyt. 1913. 76 pp., 7 pls. 15c.

Discusses methods of measuring the winter flow of streams.

345. Contributions to the hydrology of the United States, 1914. N. C. Grover, chief hydraulic engineer. 1915. 225 pp., 17 pls. 30c.

*(e) A method of determining the daily discharge of rivers of variable slope, by M. R. Hall, W. E. Hall, and C. H. Pierce, pp. 53-65. Scope indicated by title.

364. Water and analyses from the laboratory of the United States Geological Survey, tabulated by F. W. Clarke, chief chemist. 1914. 40 pp. 5c.

Contains analyses of waters from rivers, lakes, wells, and springs in various parts of the United States, including analyses of the geyser water of Yellowstone National Park, Hot springs in Montana, brines from Death Valley, water from the Gulf of Mexico, and mine waters from Tennessee, Michigan, Missouri, and Oklahoma, Montana, Colorado and Utah, Nevada and Arizona, and California.

371. Equipment for current-meter gaging stations, by G. J. Lyon. 1915. 64 pp., 37 pls. 20c.

Describes methods of installing automatic and other gages and of constructing gage wells, shelters, and structures for making discharge measurements and artificial controls.

375. Contributions to the hydrology of the United States, 1915. N. C. Grover, chief hydraulic engineer. 1916. 181 pp., 9 pls. 15c.

Contains three papers presented at the conference of engineers of the water-resources branch in December, 1914, as follows:

*(c) Relation of stream gaging to the science of hydraulics, by C. H. Pierce and R. W. Davenport, pp. 77-84.

(e) A method of correcting river discharge for a changing stage, by B. E. Jones, pp. 117-130.

(f) Conditions requiring the use of automatic gages in obtaining records of stream flow, by C. H. Pierce, pp. 131-139.

*400. Contributions to the hydrology of the United States, 1916. N. C. Grover, chief hydraulic engineer.

(a) The people's interest in water-power resources, by G. O. Smith, pp. 1-8.

*(c) The measurement of silt-laden streams, by Raymond C. Pierce, pp. 39-51.

(d) Accuracy of stream-flow data, by N. C. Grover and J. C. Hoyt, pp. 53-59.

416. The divining rod, a history of water witching, with a bibliography, by Arthur J. Ellis. 1917. 59 pp. 10c.

A brief paper published "merely to furnish a reply to the numerous inquiries that are continually being received from all parts of the country" as to the efficacy of the divining rod for locating underground water.

*425. Contributions to the hydrology of the United States, 1917. N. C. Grover, chief hydraulic engineer. 1918. Contains:

*(c) Hydraulic conversion tables and convenient equivalents, pp. 71-94. 1917.

427. Bibliography and index of the publications of the United States Geological Survey relating to ground water, by O. E. Meinzer. 1918. 169 pp., 1 pl.

Includes publications prepared, in whole or in part, by the Geological Survey that treat any phase of the subject of ground water or any subject directly applicable to ground water. Illustrated by map showing reports that cover specific areas more or less thoroughly.

ANNUAL REPORTS.

*Fifth Annual Report of the United States Geological Survey, 1883–84, J. W. Powell, Director. 1885. xxxvi, 469 pp., 58 pls. $2.25. Contains:

The requisite and qualifying conditions of artesian wells, by T. C. Chamberlin, pp. 125-173, pl. 21. Scope indicated by title.

*Twelfth Annual Report ofthe United States Geological Survey, 1890–91, J. W. Powell, Director. 1891. 2 parts. *Part II, Irrigation, xviii, 576 pp., 93 pls. $2. Contains:

*Irrigation in India, by H. M. Wilson, pp. 363–561. pls. 107-146. (See Water-Supply Paper 87.)

Thirteenth Annual Report of the United States Geological Survey, 1891–92, J. W. Powell, Director. 1892. (Parts II and III, 1893.) 3 parts. *Part III, Irrigation, xi, 486 pp., 77 pls. $1.85. Contains:

*American irrigation engineering, by H. M. Wilson, pp. 101-349, pls. 111-146. Discusses the economical aspects of irrigation, alkaline drainage, silt, and sedimentation; gives brief history of legislation; describes perennial canals in Idaho-California, Wyoming, and Arizona; discusses water storage at reservoirs of the California and other projects, subsurface sources of supply, pumping and subirrigation.

Fourteenth Annual Report of the United States Geological Survey, 1892–93, J. W. Powell, Director. 1893. (Part II, 1894.) 2 parts. *Part II, Accompanying papers, xx, 597 pp., 73 pls. $2.10. Contains:

*Natural mineral waters of the United States, by A. C. Peale, pp. 49–88, pls. 3 and 4. Discusses the origin and flow of mineral springs, the source of mineralization, thermal springs, the chemical composition and analysis of spring waters, geographic distribution, and the utilization of mineral waters; gives a list of American mineral spring resorts; contains also some analyses.

Nineteenth Annual Report of the United States Geological Survey, 1897–98, Charles D. Walcott, Director. 1898. (Parts II, III, and V, 1899.) 6 parts in 7 vols. and separate case for maps with Part V. *Part II, Papers chiefly of a theoretic nature, v. 958 pp., 172 pls. $2.65. Contains:

*Principles and conditions of the movements of ground water, by F. H. King, pp. 59-294, pls. 6-16. Discusses the amount of water stored in sandstone, in soil, and in other rocks, the depth to which ground water penetrates; gravitational, thermal, and capillary movements of ground waters, and the configuration of the ground-water surface; gives the results of experimental investigations on the flow of air and water through a rigid, porous medium and through sands, sandstones, and silts; discusses results obtained by other investigators, and summarizes results of observations; discusses also rate of flow of water through sand and rock, the growth of rivers, rate of filtration through soil, interference of wells, etc.

*Theoretical investigation of the motion of ground waters, by C. S. Slichter, pp. 295-384, pl. 17. Scope indicated by title.

Twentieth Annual Report of the United States Geological Survey, 1898–99, Charles D. Walcott, Director. 1899. (Parts II, III, IV, V, and VII, 1900.) 7 parts in 8 vols. and separate case for maps with Part V. *Part IV, Hydrography, vii, 660 pp., 75 pls. $1.40. Contains:

*Hydrography of Nicaragua, by A. P. Davis, pp. 563-637, pls. 64-75. Describes the topographic features of the boundary, the Lake Basin, and Rio San Juan; gives a brief résumé of the boundary dispute; discusses rainfall, temperature, and relative humidity, evaporation, resources and productions, the ship-railway and canal projects; gives the history of the investigations by the Canal Commission, and results of measurements on the Rio Grande, on streams tributary to Lake Nicaragua, and on Rio San Jaun and its tributaries.

Twenty-second Annual Report of the United States Geological Survey, 1900–1901; Charles D. Walcott, Director. 1901. (Parts III and IV, 1902.) 4 parts. Part IV, Hydrography, 690 pp., 65 pls. $2.20. Contains:

*Hydrography of the American Isthmus, by A. P. Davis, pp. 507–630, pls. 37–50. Describes the physiography, temperature, rainfall, and winds of Central America; discussed the hydrography of the Nicaragua canal route and the Panama canal route; gives estimated monthly discharge of many of the streams, and rainfall and evaporation tables for various points.

PROFESSIONAL PAPERS.

*72. Denudation and erosion in the southern Appalachian region and the Monongahela basin, by L. C. Glenn. 1911. 137 pp., 21 pls. 35c.

Describes the relation of agriculture, lumbering, mining, and power development to erosion and denudation, and the nature, effects, and remedies of erosion; gives details of conditions in Holston, Nolichucky, French Broad, Little Tennessee, and Hiwassee river basins, along Tennessee River proper, and in the basins of the Coosa-Alabama system, Chattahoochee, Savannah, Saluda, Broad, Catawba, Yadkin, New, and Monongahela rivers.

*86. The transportation of débris by running water, by G. K. Gilbert, based on experiments made with the assistance of E. C. Murphy. 1914. 263 pp., 3 pls. 70c.

The results of an investigation which was carried on in a specially equipped laboratory at Berkeley, Calif., and was undertaken for the purpose of learning "the laws which control the movement of bed load, and specially to determine how the quantity of load is related to the stream's slope and discharge and to the degree of comminution of the débris."

A highly technical report.

105. Hydraulic mining débris in the Sierra Nevada, by G. K. Gilbert. 154 pp., 34 pls. 1917.

Presents the results of an investigation undertaken by the United States Geological Survey in response to a memorial from the California Miners' Association asking that a particular study be made of portions of the Sacramento and San Joaquin valleys affected by detritus from torrential streams. The report deals largely with geologic and physiographic aspects of the subject, traces the physical effects, past and future, of the hydraulic mining of earlier decades, the similar effects which certain other industries induce through stimulation of the erosion of the soil, and the influence of the restriction of the area of inundation by the construction of levees. Suggests cooperation by several interests for the control of the streams now carrying heavy loads of débris.

BULLETINS.

*32. Lists and analyses of the mineral springs of the United States (a preliminary study), by A. C. Peale. 1886. 235 pp.

Defines mineral waters, lists the springs by States, and gives tables of analyses so far as available.

*319. Summary of the controlling factors of artesian flows, by Myron L. Fuller. 1908. 44 pp., 7 pls. 10c.

Describes underground reservoirs, the sources of underground waters, the confining agents, the primary and modifying factors of artesian circulation, the essential and modifying factors of artesian flow, and typical artesian systems.

479. The geochemical interpretation of water analyses, by Chase Palmer. 1911. 31 pp. 5c.

Discusses the expression of chemical analyses, the chemical character of water and the properties of natural water; gives a classification of water based on property values and reacting values, and discusses the character of the waters of certain rivers as interpreted directly from the results of analyses; discusses also the relation of water properties to geologic formations, silica in river water, and the character of the water of the Mississippi and the Great Lakes and St. Lawrence River as indicated by chemical analyses.

INDEX BY AREAS AND SUBJECTS.

[A=Annual Report; M=Monograph; B=Bulletin; P=Professional Paper; W=Water-Supply Paper; G F=Geologic folio.]

[1] Many of the reports contain brief subject bibliographies. See abstracts.
[2] Many analyses of river, spring, and well waters are scattered through publications as noted in abstracts.

INDEX OF STREAMS.

DEPARTMENT OF THE INTERIOR
FRANKLIN K. LANE, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

WATER-SUPPLY PAPER 448

GAZETTEER OF STREAMS OF TEXAS

PREPARED UNDER THE DIRECTION OF

GLENN A. GRAY

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INTRODUCTION.

The following pages contain a gazetteer of streams, lakes, and ponds as shown by the topographic maps of Texas which were prepared by the United States Geological Survey and, in areas not covered by the topographic maps, by State of Texas county maps and the post-route map of Texas. For many streams a contour map of Texas, prepared in 1899 by Robert T. Hill, was consulted, as well as maps compiled by private surveys, engineering corporations, the State Board of Water Engineers, and the International Boundary Commission. An effort has been made to eliminate errors where practicable by personal reconnaissance.

All the descriptions are based on the best available maps, and their accuracy therefore depends on that of the maps. Descriptions of streams in the central part of the State, adjacent to the Rio Grande above Brewster County, and in parts of Brewster, Terrell, Bowie, Cass, Burleson, Brazos, Grimes, Washington, Harris, Bexar, Wichita, Wilbarger, Montague, Coke, and Grayson counties were compiled by means of topographic maps and are of a good degree of accuracy. It should be understood, however, that all statements of elevation, length, and fall are roughly approximate.

The Geological Survey topographic maps used are cited in the descriptions of the streams and are listed below. An index circular showing the area covered by each map may be obtained by applying to the Director, United States Geological Survey, Washington, D. C.

Abilene
Addicks
Agua Fria
Albany
Aldine
Alief
Almeda
Alpine
Anson
Atlanta
Austin
Bellaire
Ballinger
Barnes Bridge
Barwise School
Bastrop
Blanco
Brackett
Brady
Breckenridge
Brownwood
Buck Hill
Buckholts
Bullis Gap
Burkburnett
Burnet
Burnett Bay
Cedar Bayou
Cerro Alto
Chisos Mountains

GAZETTEER.

Acero or Tranquitas Creek.—Jim Wells and Kleberg counties; rises in the eastern part of Jim Wells County; flows southeastward 22 miles into San Fernando Creek, thence to Gulf of Mexico through Baffins Bay.

Adams Branch.—Brown County; a stream 8 miles long flowing through the town of Brownwood in the southeastern part of the county; empties into Pecan Bayou and thus to the Colorado. Coleman and Brownwood topographic maps.

Adams Bayou.—Orange County; rises in the north central part of the county; flows southeasterly 11 miles into Sabine River (tributary to Sabine Lake and thus to Gulf of Mexico) about a mile south of Orange.

Adobe Creek.—Hutchinson County; an intermittent stream rising 16 miles northeast of Plemons and flowing southeasterly 8 miles to its junction with Canadian River (tributary to Arkansas River and thus to the Mississippi) 12 miles northeast of Plemons in eastern part of county.

Adams Creek.—Wilbarger County; rises in northeastern part 7 miles northwest of Electra; flows northeasterly into Red River and thus to the Mississippi; intermittent. Electra topographic map.

Agua Caballo or Horse Creek.—Oldham County; an intermittent stream rising in extreme northwestern corner of county and flowing southeasterly 13 miles into Canadian River (tributary to Arkansas River and thus to the Mississippi) 15 miles north of Adrian in northwestern part of county.

Agua Dulce Creek.—Rises in the northwestern part of Jim Wells County; flows southwestward 12 miles into Santa Petronilla Creek (thence through Baffins Bay to Gulf of Mexico) 5 miles north of Driscoll.

Agua de Fuera Creek.—Kinney County; rises 8 miles northeast of Brackett; flows southeasterly 25 miles to Kinney-Maverick county line, where it enters Elm Creek (tributary to Nueces River) intermittent. Brackett topographic map.

Agua Negro Creek.—Atascosa County; rises in northern part of county; flows southerly 5 miles into Palo Alto Creek (tributary through Atascosa and Frio rivers to the Nueces).

Agua Piedra.—Oldham County; rises 5 miles northeast of Adrian; flows northwesterly 13 miles into Trujillo Creek (tributary to Canadian River, and thus through the Arkansas to the Mississippi) 13 miles north of Adrian in western part of county.

Alabama Creek.—Trinity County; rises in eastern part of county; flows easterly 11 miles into Neches River near intersection of Trinity and Polk county line east of Nathan.

Alabama, Village, or Big Sandy Creek.—Polk and Hardin countries; rises about 3 miles southeast of Moscow in Polk County; flows southeasterly 63 miles into Neches River about 2 miles east of Fletcher in Hardin County.

Alamo Creek.—Motley County; a stream 8 miles long rising in the northwestern part of county and flowing northeastward into Quitaque Creek (tributary to Pease River and thus through Red River to the Mississippi).

Alamito Creek.—Webb County; [illegible] northward to its junction with Salado Creek [illegible] Nueces River in the northeastern part of county.

Alamito Creek.—Presidio and Jeff Davis counties; rises 22 miles north of Marfa near Jeff Davis-Presidio county line at an approximate altitude of 5,250 feet above sea level; [illegible] Marfa then [illegible] miles via Alamito into Rio Grande 5 miles southeast of Presidio. Intermittent. Marfa, Alpine, and Shafter topographic maps.

Alamositas Creek.—Oldham County; an intermittent stream rising 10 miles northwest of Adrian and flowing northward 18 miles to its junction with Canadian River (tributary to Arkansas River and thus to the Mississippi) 15 miles west of Cheyenne in central part of county.

Alarm Creek.—Erath County; rises 7 miles southwest of Stephenville; flows southeasterly 13 miles into Bosque River (tributary to Brazos River) 4 miles northeast of Alexander in southern part of county. Stephenville topographic map.

Alexander Creek.—Hamilton County; a partially intermittent stream in central part of county; flows northeasterly 18 miles into Leon River (tributary through Little River to the Brazos) 7 miles northeast of Hamilton. Hamilton topographic map.

Alkali Creek.—Fisher County; a small stream flowing eastward 12 miles into Cottonwood Creek (which discharges into Brazos River through Clear Fork of the Brazos) 2 miles north of Roby in western part of county. Roby topographic map.

Allen Creek.—Fannin County; rises in southern part of county; flows into North Sulphur River (tributary to Sulphur River and thus through Red River to the Mississippi).

Allen Creek.—Lee County; a stream flowing southeasterly 10 miles into Second Yegua Creek (tributary to Yegua Creek and thus to the Brazos) in northern part of county. Bastrop topographic map.

Allen's or Eightmile Creek.—Austin County; rises near Sealy in southern part of county; flows southeasterly 15 miles into Brazos River near Wallis.

Allen's Branch.—Tarrant County; a short stream west of Fort Worth; joins Serugan Branch (tributary to West Fork of Trinity River and thus to the Trinity) about 5 miles west of Fort Worth. Weatherford and Fort Worth topographic maps.

Alleys Creek.—Lee County; rises near Hicks near Milam-Lee county line; flows southeasterly 6 miles into First Yegua Creek (tributary through Yegua Creek to Brazos River).

Alley Creek.—Cass and Marion Counties; rises in southwestern part of Cass County; flows southeasterly 13 miles into Big Cypress Bayou (tributary to Caddo Lake and thus through Red River to the Mississippi) in southwestern part of Marion County.

Alligator Bayou.—Jefferson County; rises 3 miles northwest of Port Arthur in the eastern part of the county; flows southerly 7 miles into Taylor's Bayou (tributary through Sabine Lake to Gulf of Mexico) 2 miles southwest of Port Arthur; tidal; channel not defined; drains large areas of marshy and higher lands north of Port Arthur.

Alligator Creek.—Falls and Robertson counties; rises north of Bremond; flows southwesterly along county line 7 miles and empties into Little Brazos River (tributary to the Brazos).

Alligator Creek.—Williamson and Milam counties; a small stream joining San Gabriel River (tributary to Little River and thus to the Brazos) 5 miles east of San Gabriel in western part of Milam County. Taylor topographic map.

ALLIGATOR CREEK.—Leon and Freestone counties; rises about 3 miles northwest of Jewett in Leon County; flows northeasterly 7 miles into Buffalo Creek (tributary through Upper Keechi Creek to Trinity River) near county line in southern part of Freestone County.

ALPINE CREEK.—Brewster County; rises about 6 miles east of Paisano; flows 10 miles northeasterly through the town of Alpine to a point 3 miles north of Alpine, where it joins Paisano Creek (tributary to Pecos River and thus to Rio Grande). Alpine topographic map.

ALUM CREEK.—Bastrop County; rises 3 miles south of McDade in the northeastern part of county; flows southerly 17 miles into Colorado River, 4 miles northwest of Smithville. Bastrop topographic map.

ALUM CREEK.—Bastrop County; a small intermittent stream in southwestern part of county joining Walnut Creek (tributary to Colorado River) 1½ miles east of Otis; length, 7 miles. Austin and Bastrop topographic maps.

AMARILLO CREEK.—Potter County; rises near Soncy near to south line of county; flows northerly 20 miles through Probst into Canadian River, thence to Arkansas River and thus to the Mississippi.

AMARGOSO CREEK.—Jim Wells County; small stream in northwestern part of county, flowing southeasterly 10 miles into Chiltipin Creek (tributary through Pinias and Santa Petronilla creeks to Baffins Bay and thus to the Gulf of Mexico).

ANACUAS CREEK.—Duval and Jim Wells counties; rises in the central part of Duval County; flows southeastward 15 miles through Duval County, then 9 miles through Jim Wells County into Santa Gertrudis Creek (tributary to Baffins Bay and thus to Gulf of Mexico) near eastern line of Jim Wells County.

ANADARKO OR BARNHART CREEK.—Rusk County rises about 4 miles southeast of Henderson; flows southwesterly 11 miles into Big Shawnee Creek (tributary to Angelina River and thus to the Neches).

ANAQUITAS CREEK.—Duval and Jim Wells counties; small stream flowing into San Diego Creek (tributary through Chiltipin and Pinias to Santa Petronilla Creek and thus through Baffins Bay to Gulf of Mexico) in northeastern part of Duval County and northwestern part of Jim Wells County.

ANDERSON CREEK.—Angelina County; flows northeasterly about 6 miles into Angelina River (tributary to the Neches) at Marion in northeastern part of county.

ANDERSON CREEK.—Zavalla and Dimmitt counties; a small intermittent stream rising in the southern part of Zavalla County and flowing southward into Dimmitt County to its junction with Nueces River.

ANDERSON CREEK.—Red River and Bowie counties; rises in the eastern part of Red River County about 3½ miles southwest of Avery; flows southeasterly 33 miles into Sulphur River (tributary to Red River which discharges into the Mississippi) about 3 miles southwest of Corley in southwestern part of Bowie County. New Boston topographic map.

ANDYS OR JAKES CREEK.—Franklin and Titus counties; rises in southern part of Franklin County; flows southeasterly 11 miles into Big Cypress Bayou (tributary to Caddo Lake which discharges into the Mississippi through Red River) in southwestern part of Titus County.

ANGELINA RIVER.—Rusk, Smith, Cherokee, Nacogdoches, Angelina, San Augustine, and Jasper counties; rises in southwestern part of Rusk County; flows southeasterly 119 miles into Neches River about 12 miles west of Jasper in the northwestern part of Jasper County.

ANTELOPE CREEK.—Hutchinson and Carson counties; rises in western part of Carson County, northwest of Panhandle; flows northerly 22 miles into Canadian River (tributary to Arkansas River and thus to the Mississippi) in southwestern part of Hutchinson County.

ANTELOPE CREEK.—Shackleford County; rises 1 mile south of Antelope Hills in northern part of county; flows northwestward 7 miles into Clear Fork of Brazos River (tributary to the Brazos). Albany topographic map.

ANTELOPE CREEK.—Lampasas County; a small stream flowing 9 miles to its junction with Colorado River 2 miles southeast of Red Bluff in southwestern part of county. Lampasas and San Saba topographic maps.

ANTELOPE CREEK.—San Saba County; rises in the northwestern part of the county; flows 7 miles into Colorado River. Brady and San Saba topographic maps.

ANTELOPE CREEK.—Briscoe and Hall counties; rises in the eastern part of Briscoe County; flows northeasterly 7 miles into Prairie Dog Town Fork of Red River (tributary to Red River and thus to the Mississippi) in northwestern part of Hall County about one-half mile east of the west boundary of county.

ANTELOPE CREEK.—Baylor and Throckmorton counties; a stream 4 miles long flowing northwesterly to its junction with Millers Creek (tributary to Brazos River) in southern part of Baylor County.

ANTELOPE CREEK.—Nolan County; rises west of Blackwell in southern part of county; flows into Oak Creek (tributary to Colorado River); length, 11 miles. Sweetwater topographic map.

ANTELOPE CREEK.—Wichita County; rises 7 miles southwest of Iowa Park; flows northeasterly, northwesterly, and easterly 5 miles into Wichita River (tributary to Red River and thus to the Mississippi); small; intermittent. Iowa Park topographic map.

APACHE CANYON.—El Paso and Culberson counties; rises in eastern part of El Paso County; flows easterly and sinks in sands in western part of Culberson County 30 miles north of Van Horn; intermittent. Sierra Blanca and Van Horn topographic maps.

AQUILLA CREEK.—McLennan and Hill counties; rises 2 miles northwest of Covington in northern part of Hill County; flows southerly 45 miles into Brazos River 8 miles northwest of Waco in the northern part of McLennan County. Cleburne and Waco topographic maps.

ARANSAS RIVER.—Bee, Refugio, and San Patricio counties; rises in the central part of Bee County; flows southeastward 27 miles through Bee County, then 20 miles along the boundary of Refugio and San Patricio counties into the head of Copano Bay an arm of the Gulf of Mexico.

ARENOSA CREEK.—Victoria and Jackson counties; rises on the northern boundary of Victoria County; flows southeastward 28 miles forming the boundary of Jackson and Victoria counties into Lavaca Bay (which discharges into Gulf of Mexico through Matagorda Bay).

ARENOSA CREEK.—San Augustine County; rises in south central part of county; flows southeasterly 8 miles into Ayish Bayou (tributary to Angelina River and thus to the Neches).

ARENOSA CREEK.—Kinney County; small flood water stream rising in southern part of county and flowing southeasterly into Elm Creek (tributary to Nueces River); length, 19 miles. Brackett topographic map.

ARENOSA CREEK.—Shelby and San Augustine counties; rises in the southwestern part of Shelby County; flows southwesterly 12 miles into Attoyac Bayou (tributary to Angelina River and thus to the Neches) in the northwestern part of San Augustine County.

Armstrong Creek.—Comanche and Erath counties; formed 4½ miles west of Lingleville in the western part of Erath County by the union of the East and West Forks of Armstrong Creek; flows southward 20 miles into Leon River (tributary to Little River and thus to the Brazos) 9 miles west of Dublin in northeastern part of Comanche County. Stephenville topographic map.

Armstrong Creek, West Fork.—Erath County; rises near Smith Gap; flows southward 6 miles to its junction with East Fork of Armstrong Creek to form Armstrong Creek (tributary through Leon and Little rivers to the Brazos) in the western part of county, 4½ miles west of Lingleville. Stephenville topographic map.

Armstrong Creek, East Fork.—Erath County; rises northwest of Lingleville in western part of county; flows southwestward 6 miles to its junction with West Fork of Armstrong Creek forming Armstrong Creek (tributary through Leon and Little rivers to the Brazos) 4½ miles west of Lingleville in western part of county. Stephenville topographic map.

Armstong Creek.—Cass County; a small intermittent stream flowing into Shoal Creek (tributary to Sulphur River, which discharges into Mississippi River through the Red) about 3 miles northwest of Anti School in northern part of county. Linden topographic map.

Arroyo Amaladeros.—Nacogdoches County; flows southeasterly 9 miles into Attoyac Bayou (tributary to Angelina River and thus to the Neches) in eastern part of county.

Arroyo Colorado.—Hidalgo and Cameron counties; rises in southeastern part of Hidalgo County; flows eastward and northeastward 4 miles through Hidalgo County, then 35 miles through the central part of Cameron County into the Laguna Madre, an arm of the Gulf of Mexico; length, 39 miles. Intermittent. Tidal about 24 miles from its mouth. Mission and San Juan topographic maps.

Arroyo de los Angeles.—Webb, Duval, and Jim Hogg counties; small stream rising in the southeastern part of Webb County and flowing southeastward across corner of Duval County 16 miles to its junction with Noriacitas Creek (tributary to Palo Blanco Creek, thence through Laguna Madre and Baffins Bay to Gulf of Mexico) in northern part of Jim Hogg County.

Arroyo Dulce.—Austin County; a stream 3 miles long flowing into Brazos River at San Felipe.

Arroyo del Quenada.—Starr County; rises northeast of Salinero in the western part of the county; flows southerly 5 miles into Casas Blancas Creek (tributary to Rio Grande).

Arroyo Lagarto.—Live Oak, Duval, and Jim Wells counties; rises in the southwestern corner of Live Oak County; flows southeasterly 4 miles through the corner of Live Oak County, 4 miles through Duval County, then eastward and northeastward 9 miles through Jim Wells County, thence 13 miles through the southeastern part of Live Oak County into Nueces River near Lagarto; length, 30 miles.

Arroyo Negro.—Zavalla and Dimmit counties; rises in southern part of Zavalla County about 2 miles west of Loma Vista; flows southeasterly 10 miles through Zavalla County, then 15 miles through Dimmit County into Nueces River about 2 miles south of Valley Wells.

Arroyo Nombre de Dios.—San Patricio County; rises in western part of county; flows southeasterly and southwesterly 7 miles into Nueces River.

Arroyo Palo Alto.—Victoria County; rises in the central part of County; flows southeastward 6 miles into Union Creek, thence to Lavaca and Matagorda bays and thus to the Gulf of Mexico.

[illegible] stream in southeastern part [illegible] southerly [illegible] map.

[illegible] southwestern part [illegible] tributary [illegible] south of [illegible].

[illegible] stream in southwestern part of [illegible] 5 miles into [illegible] topographic map.

[illegible] southeastern part [illegible] of Boquillas. Chisos [illegible].

[illegible] part of the county; flows [illegible].

[illegible] miles southeast of [illegible] Creek (tributary [illegible] map.

[illegible] part of county; flows northward [illegible] River to [illegible] miles east of [illegible].

[illegible] northwestern part of [illegible] flows southeasterly 13 [illegible] River (tributary to [illegible] River) about 3 [illegible] county. Weather-[illegible].

Atascosa River—[illegible] rises in northwestern corner [illegible] miles through Atascosa County [illegible] into Frio River (tributary to Nueces River) near Three Rivers.

A[illegible] Creek—[illegible] in the west central part of the county; flows [illegible] miles into West San Jacinto River (tributary to San Jacinto River and thus through [illegible] Bay to Gulf of Mexico).

A[illegible] Bayou—Rusk, [illegible] and San Augustine counties; rises 3 miles east of [illegible] in the southeastern part of Rusk County; flows southeasterly [illegible] miles into Angelina River (tributary to Neches River) at the southeastern corner of Nacogdoches County near the St. Louis Southwestern Railway crossing.

A[illegible] Creek—Sabine County; flows easterly 3 miles into Sabine River in the southeastern part of county.

Austin Bayou—Brazoria County; rises near R[illegible] in the north central part of the county; flows southeasterly [illegible] miles into Bastrop Bay and thus to the Gulf of Mexico.

Autumn Creek.—Motley County; rises in the southeastern part; flows northeasterly 6 miles into Salt Creek (tributary through South Pease and Middle Pease rivers to Pease River and thus through Red River to the Mississippi).

Avary Canyon.—Brewster County: flows into Tornillas Creek (tributary to Rio Grande) 15 miles northwest of Boquillas in southern part of county. Chisos Mountains topographic map.

Avarillas.—Atascosa County; a small stream flowing southeasterly 6 miles into Atascosa River (tributary through Frio River to the Nueces) in the northern part of the county, near Coughran.

Ayish Bayou.—San Augustine and Jasper counties; rises about 5 miles north of the town of San Augustine in San Augustine County; flows southerly 40 miles into Angelina River (tributary to Neches River) in northwestern part of Jasper County.

Babyhead Creek.—Llano County; an intermittent stream flowing into Pecan Creek (tributary through Llano River to the Colorado) 6 miles east of Valley Spring in the northern part of the county; length, 9 miles. Llano topographic map.

Backbone Creek.—Burnet County; small stream rising 3 miles north of Fairland in the southern part of the county; flows southward 10 miles into Colorado River at Marble Falls. Burnet topographic map.

Baer Creek.—Sabine and Jasper counties; rises near Bronson in the southwestern part of Sabine County; flows southerly into Ayish Bayou (tributary to Angelina River, and thus to the Neches) in northern part of Jasper County.

Bailey Creek.—Clay County; an intermittent stream flowing into Red River (tributary to the Mississippi) northeast of Byers in northern part of county.

Bailey Creek.—Brazoria County; rises in western part of county; flows southeasterly 5 miles into Varners Creek (tributary to Brazos River) south of Damon.

Bailey Branch.—Fisher and Stonewall counties; rises 4 miles west of Hitson in northeastern part of Fisher County; flows northerly 8 miles into Double Mountain Fork of Brazos River (tributary to Bazos River) in southern part of Stonewall County. Roby topographic map.

Baker Creek.—Cass County; rises about 1½ miles north of Lanark in northeastern part of county; flows northeasterly 9 miles into Baker Slough, an expansion of Baker Creek (tributary to Sulphur River and thus through Red River to the Mississippi) about 1½ miles east of Alamo Mills. Texarkana and Atlanta topographic maps.

Baker Creek.—Hardeman County; a stream 7 miles long flowing eastward through northwestern part of county and discharging into Red River (tributary to the Mississippi).

Bakers Lake.—Harris County; 3½ miles west of Crosby in eastern part of county; small. Crosby topographic map.

Baker Slough.—Cass County; about 2 miles east of Alamo Mills; an arm of Long Slough (tributary to Sulphur River and thus through Red River to the Mississippi). Texarkana topographic map.

Balcones Creek.—Kendall, Bexar, and Bandera Counties; rises southwest of the town of Boerne in the eastern corner of Bandera County; flows easterly 8 miles along the boundary of Kendall and Bexar counties for practically this entire distance; joins Rio Cibolo (tributary through San Antonio River to the Guadalupe) north of Van Raub.

Balcon Creek.—Terrell County; rises in southwestern part about 2 miles southeast of Taylors ranch; flows southeasterly 4½ miles into Indian Creek (tributary to Rio Grande) near Johnsons ranch; intermittent. Dryden Crossing topographic map.

Baldridge Creek.—Gonzales County; rises near Waelder; flows southeasterly 9 miles into Peach Creek (tributary to Guadalupe River). Flatonia topographic map.

Ballard Creek.—Cass County; a small intermittent stream connecting with Shoal Creek (tributary through Sulphur River to Red River and thus to the Mississippi) about 3½ miles northeast of Douglasville in northern part of county. Linden topographic map.

[illegible]

[illegible] County: rises 2 miles northwest of the [illegible] flows northwesterly 11 miles [illegible] to Red River, which discharges into the Missi[illegible] in northern part of county. [illegible]

[illegible] rises about 2 miles south of [illegible] flows south[illegible] [illegible] tributary to Sulphur River and thus [illegible] about 3 miles east of Redwater. [illegible]

[illegible] County small stream flowing north 4 miles into [illegible] of Red River (tributary to Red River and thus [illegible] in [illegible] part of county.

BARRONS CREEK.—Gillespie County; flows southeasterly 15 miles through the town of Fredericksburg into Pedernales River (tributary to the Colorado) 4 miles southeast of Fredericksburg, in the southern part of the county. Fredericksburg topographic map.

BARTON CREEK.—Hays and Travis counties; rises 4 miles northwest of Dripping Springs, in the northern part of Hays County; flows easterly 9 miles through Hays County, then 25 miles through Travis County into Colorado River in the southwestern part of the City of Austin; gaging station maintained at Austin. Blanco and Austin topographic maps.

BARTON CREEK.—Donley County; rises about 3 miles west of Evans in the northern part of county; flows southeasterly 11 miles into Saddlers Creek (tributary to Salt Fork of Red River, thence to Prairie Dog Town Fork of the Red and thus through Red River to the Mississippi).

BARTON CREEK, SALT FORK.—Erath County; rises 1 mile south of Twin Mountains in northern part of county; flows northerly 5 miles into Barton Creek (tributary to Palo Pinto Creek and thus to Brazos River) 2 miles east of Washout Mountain. Stephenville topographic map.

BARTON CREEK.—Palo Pinto and Erath counties; rises 6 miles southwest of Wyleyville in northern part of Erath County; flows northerly 21 miles into Palo Pinto Creek (which discharges into Brazos River) one mile northwest of Coalville. Stephenville and Palo Pinto topographic maps.

BARTON CREEK.—Gonzales County; small tributary to Guadalupe River in the eastern part of the county.

BARTON'S CREEK.—Dewitt County; rises in northern part of county near Hochheim; flows into Queens Creek (tributary to Guadalupe River).

BASON MILL CREEK.—Red River County; rises about 9 miles north of Clarksville in northern part of county; flows northeasterly into Red River (tributary to the Mississippi) 1½ miles northwest of Mound City; length 9 miles.

BASFORDS BAYOU.—Galveston County; rises near Arcadia in the southwestern part of the county; flows southeasterly 5 miles into West Galveston Bay and thus to Gulf of Mexico.

BASS CREEK.—Gonzales County; rises east of the town of Gonzales; flows into Kerr Creek (tributary to Guadalupe River); intermittent. Flatonia topographic map.

BASSETT OR BLYTHE CREEK.—Bowie County; rises about 2 miles northeast of Dalby Springs in western part of county; flows southeasterly 13 miles into Sulphur River (which discharges into the Mississippi through Red River) about 2 miles south of Berry.

BASTROP BAYOU.—Brazoria County; rises in the central part of the county; flows southeasterly 13 miles into Austin Bayou, thence to Gulf of Mexico through Bastrop Bay.

BATES CREEK.—Comal County; near Crane's Mill; small intermittent stream flowing through northern part of county into Guadalupe River.

BATTLE CREEK.—Armstrong, Briscoe, and Hall counties; rises near Paloduro in southeastern part of Armstrong County; flows southeasterly 12 miles into Prairie Dog Town Fork of Red River (tributary to Red River, which discharges into the Mississippi) in northwestern part of Hall County near the western county line

BATTLE CREEK.—Shackelford, Stephens, and Callahan counties; rises in north east corner of Callahan County; flows northeasterly 18 miles into Bear Creek (tributary through Sandy Creek to Hubbard Creek, thence through Gonzales Creek to Clear Fork of Brazos and Brazos rivers) near Shady Grove. Albany topographic map.

Bayou Visitador.—Nacogdoches County; rises in the eastern part; flows southerly 17 miles into Angelina River (tributary to the Neches) in the southeastern part of the county.

Bayou Wander.—Nacogdoches County; rises in northeastern part of county; flows southeasterly 11 miles into Naconichi Bayou and thus through Attoyac Bayou to Angelina and Neches rivers.

Beach Branch.—Cass County; rises 3 miles northwest of Linden in central part of county; flows southeastward into Jims Bayou (tributary through Frazier Creek to Caddo Lake and thus through Red River to the Mississippi).

Beach Creek.—Cass County; rises about a mile east of Grogans Mill in the central part of county; flows easterly 5 miles into Black Bayou (tributary to Caddo Lake and thus to Red and Mississippi rivers) near Arnolds sawmill, 4 miles northeast of Bivins.

Bead Mountain Creek.—Coleman County; small stream rising west of Valera in the western part of county north of Bead Mountain; and flowing southeasterly 5 miles into Home Creek (tributary to the Colorado). Ballinger topographic map.

Beane Creek.—Hunt County; rises about 7 miles northwest of Greenville; flows southeasterly 18 miles into Caddo Fork of Sabine River (tributary to Sabine River).

Beane Creek, East Fork of.—Hunt County; rises 6 miles northwest of the town of Greenville; flows southerly into Beane Creek, thence through Caddo Fork of the Sabine to Sabine River.

Bear Bayou.—Shelby County; small stream flowing into Attoyac Bayou (tributary to Angelina River and thus to the Neches) in western part of the county.

Bear Branch.—Gonzales County; rises in northeastern part of county; flows into Peach Creek (tributary to Guadalupe River) northwest of Moulton; intermittent. Flatonia topographic map.

Bear Creek.—Angelina County; rises about 5 miles southwest of Homer; flows southerly 11 miles into Neches River.

Bear Creek.—Brewster County; rises in eastern part about 3 miles southwest of Gage ranch; flows southwesterly into an unnamed creek and thus to Rio Grande; intermittent. Dove Mountain and Bone Spring topographic maps.

Bear Creek.—Comal County; An intermittent stream near Sattler in central part of county; empties into Guadalupe River.

Bear Creek.—Cass County; rises 2 miles west of Munz in northwestern part of county; flows southwesterly 8 miles into Kelley Creek (tributary to Black Cypress Bayou, thence through Big Cypress Bayou and Caddo Lake to Red River and thus to the Mississippi). Daingerfield topographic map.

Bear Creek.—Collin County; formed 3 miles east of Blue Ridge by union of Little Bear and Indian creeks; flows southwesterly 5 miles into Pilot Grove Creek (tributary through Sister Grove Creek to East Fork of Trinity River and thus to the Trinity) about 2 miles south of Blue Ridge.

Bear Creek.—Dallas and Ellis counties; rises near De Soto in southern part of Dallas County; flows southeasterly 18 miles into Red Oak Creek (tributary to Trinity River) in the northeastern part of Ellis County. Dallas topographic map.

Bear Creek.—Eastland County; rises 5 miles southwest of Round Mountain in northeastern part of county; flows northeasterly 9 miles into South Palo Pinto Creek (tributary to Palo Pinto Creek and thus to Brazos River) in northeast corner of county. Eastland topographic map.

[illegible] Big Sandy Creek [illegible] River near Palo Pinto [illegible] maps.

[illegible] county; flows [illegible] to Buffalo [illegible] miles southeast [illegible] map.

[illegible] Junction [illegible] the Brazos) [illegible] map.

[illegible] of Hays and [illegible] Austin [illegible]

[illegible] of county; [illegible] Cleburne [illegible]

[illegible] part of [illegible] River (which [illegible] miles east of [illegible]

[illegible] of county; [illegible] the Guadalupe [illegible]

[illegible] town of Junction [illegible] River [illegible] Fort McKavett [illegible]

[illegible] corner of [illegible] River (tributary [illegible] Fredericksburg [illegible]

[illegible] of county; flows south- [illegible] Pease River [illegible] about 3 miles southwest of [illegible]

[illegible] western part of county; flows [illegible] length 22 miles. Mason topo- [illegible]

[illegible] rises about 3 miles northwest of [illegible] flows southeasterly 17 miles into Clear Fork of [illegible] West Fork of Trinity River and thus to Trinity River) 2 [illegible] of Bear Creek post office, in southwestern part of Tarrant County. Weatherford topographic map.

Bear Creek. Polk County; small stream flowing southerly 11 miles into Alabama Creek (tributary to Neches River), in the east central part of county.

Bear Creek. Sabine, San Augustine, and Jasper counties; rises in western part of Sabine County; flows southerly 16 miles near to the western boundary of county; enters Ayish Bayou (tributary through Angelina River to the Neches) in the northwestern corner of Jasper County.

Bear Creek [illegible] Stephens County; rises near the Shackleford-Stephens County [illegible] flows easterly 7 miles into Sandy Creek (tributary through Hubbard [illegible] Creek, thence through Clear Fork of Brazos River to the [illegible] near Hog Mountain in western part of county. Albany topo-

BEAR CREEK.—Williamson and Burnet counties; rises 2 miles northwest of Bertram in eastern part of Burnet County; flows northeasterly 10 miles into North Fork of San Gabriel River (tributary through San Gabriel River to Little River and thus to the Brazos) 3 miles south of Gabriel Mills. Burnet and Georgetown topographic maps.

BEAR OR GUM CREEK.—Upshur County; rises about 4 miles west of Coffeyville in northeastern part of county; flows southerly 9 miles to Little Cypress Creek (tributary to Caddo Lake, which discharges into Mississippi River through Red River) west of Graceton.

BEAR CREEK.—Wichita and Clay counties; rises in northeastern part of Wichita County; flows easterly 2 miles into Wichita River (tributary to Red River and thus to the Mississippi) in northwestern part of Clay County.

BEAR CREEK.—Washington County; rises 2 miles northwest of Gay Hill; flows northerly 2½ miles into Wolf Creek (tributary to Yegua Creek and thus to Brazos River).

BEARS FOOT CREEK.—Runnels County; an intermittent tributary to Colorado River east of Ballinger in the southern part of the county; length, 5 miles. Ballinger topographic map.

BEARHEAD CREEK.—Cooke County; rises about a mile southwest of the town of Sivells Bend in northern part of county; flows southeasterly 5 miles into Fish Creek, thence to Red River and thus to the Mississippi. Gainesville topographic map.

BEAR-PEN CREEK.—Franklin County; rises one-half mile south of Mount Vernon in central part of county; flows northerly 7 miles into Whiteoak Bayou (tributary to Sulphur River, which discharges into the Mississippi through Red River).

BEAR-PEN CREEK.—Collin and Hunt counties; rises at Nevada in Collin County; flows southeasterly 15 miles into Bluff Creek (tributary to South Fork of the Sabine and Sabine Rivers) about 3 miles southwest of Quinlan in Hunt County.

BEAR SPRINGS BRANCH.—Llano County; an intermittent stream 6 miles in length flowing southeast of Castell in the western part of the county; connects with Lang Creek and thus to Llano River (tributary to Colorado River). Llano topographic map.

BEAR GULCH.—Caldwell County; small stream flowing to the southwest of Delhi, in eastern part of the county, into Sandy Fork of Peach Creek (tributary to Peach Creek and thus to the Guadalupe); intermittent. Flatonia topographic map.

BEASONS CREEK.—Grimes County; rises near Retreat; flows westerly 12 miles into Brazos River near western corner of Grimes and Waller Counties; Howth and Navasota topographic maps.

BEASOM OR BEASON CREEK.—Grimes County; rises in southern part of county; flows southwesterly 12 miles into Brazos River at the Grimes-Waller County line. Navasota and Howth topographic maps.

BEAVER CREEK.—Clay and Montague Counties; rises about 8 miles north of Bellevue in eastern part of Clay County; flows northeastward 14 miles into Red River (tributary to Mississippi River) 4 miles northeast of Ringgold, in northwestern part of Montague County. Montague topographic map.

BEAVER CREEK.—Anderson County; rises in northwestern part of county; flows southwesterly 11 miles into Catfish Bayou (tributary to Trinity River).

BEAVER CREEK.—Burnet County; a stream 8 miles long connecting with Colorado River 2½ miles northwest of Blufton in the northwestern part of the county. Burnet topographic map.

Beaver Creek.—Foard, Wilbarger, and Wichita counties; rises about 3 miles east of Foard City in southern part of Foard County; flows easterly 65 miles into Wichita River (tributary to Red River, which discharges into the Mississippi) about 7 miles south of Fowlkes in southwestern part of Wichita County.

Beaver Creek.—Grayson County; rises about a mile north of Southmayd in western part of county; flows northerly 5 miles into Mineral Creek (tributary to Red River and thus to the Mississippi) one mile southwest of Steedman. Denison topographic map.

Beaver Creek.—Gillespie and Mason counties; rises about 3 miles north of Harper in the northwestern part of Gillespie County; flows northeastward 28 miles into Llano River (tributary to the Colorado) 2 miles east of Hedwig's Hill in the eastern part of Mason County. Mason and Kerrville topographic maps.

Beaver Creek.—Leon County; a stream 5 miles long flowing easterly into Beaver Dam Creek (tributary to Trinity River) in eastern part of county.

Beaver Creek.—Van Zandt and Henderson counties; rises in the southeastern part of Van Zandt County; flows southerly into Kickapoo Creek (tributary to Neches River) in the northeastern part of Henderson County.

Beaver Creek.—Leon County; rises about 3 miles west of Centerville; flows easterly 7 miles into Keechi Creek (tributary to Trinity River).

Beaver Dam Creek.—Leon County; rises in central part of county; flows southeasterly 10 miles into Trinity River; about 5 miles above its mouth it spreads over extensive marshes formed by beaver dams.

Beaver Lake.—Val Verde County; formed 3 miles northeast of Juno and 8 miles south of Crocket and Val Verde County line by an expansion of Devils River (tributary to Rio Grande).

Beauchamps Creek.—Harris County; a small tributary in the central part of the county; flows 7 miles into Whiteoak Bayou and thus to Buffalo Bayou, Galveston Bay and Gulf of Mexico.

Becerra Creek.—Webb County; small intermittent stream flowing southerly 8 miles to its junction with Rio Grande approximately 15 miles south of the town of Laredo.

Beck Branch.—Hamilton County; a short intermittent stream in eastern part of county; rises near Cut Off Mountain; flows southerly 7 miles to a point 4½ miles northwest of Jonesborough, where it enters Leon River (tributary through Little River to the Brazos). Meridian topographic map.

Bedias Creek.—Montgomery County; rises in the west central part of the county; flows southerly and southwesterly 8 miles into Lake Creek (tributary to West San Jacinto River, San Jacinto River, and Gulf of Mexico).

Bee Branch.—Gonzales County; small stream in northern part of county; flows southerly 7 miles into Sandy Fork of Peach Creek (tributary through Peach Creek to Guadalupe River) east of Thomsonville; intermittent. Flatonia topographic map.

Bee Branch.—Falls County; a small intermittent stream flowing southerly 3 miles into Pond Creek (tributary to the Brazos) south of the village of Rupee. Temple topographic map.

Bee Branch.—Brown County; a small intermittent stream flowing through Blanket Creek into Pecan Bayou (and thus to the Colorado) south of Zephyr in the southeastern part of the county; length, 6 miles. Brownwood topographic map.

Bee Creek.—Bosque County; an intermittent stream flowing southeasterly 7 miles into Meridian Creek (tributary to Bosque River and thus to the Brazos) south of the town of Meridian. Meridian topographic map.

Bee Creek.—Brazos County; a stream 6 miles long flowing northeasterly into Big Cedar Creek (tributary to Navasota River and thus to the Brazos).

Bee Creek.—Caldwell and Bastrop counties; a small stream flowing northward from Taylorsville in the northern part of Caldwell County, and connecting with Walnut Creek (tributary to Colorado River) in western part of Bastrop County. San Marcos and Flatonia topographic maps.

Bee Creek.—Ellis County; joins Pecan Creek (tributary to Richland Creek thence to Trinity River) in southwestern part of the county.

Bee Creek.—Cass County; rises about 2½ miles northwest of O'Farrell school; flows southeasterly into Johns Creek (tributary to Frazier Creek and thus through Caddo Lake and Red River to the Mississippi) about 2 miles north of Spring Hill in northern part of county; length, 6 miles.

Bee Creek.—Fort Bend County; rises in southern part of county; flows southeasterly 6 miles into Cow Creek (tributary to the Brazos).

Bee Creek.—Hood County; rises 2 miles southeast of Center Mill in northeastern part of county; flows southerly 6 miles into Brazos River 2½ miles northwest of Granbury. Weatherford and Granbury topographic maps.

Bee Creek.—Travis County; a small intermittent tributary to Colorado River just above the city of Austin in the central part of county; length, 3 miles. Austin topographic map.

Bee Creek.—Travis County; rises in the northwestern part of the county; flows 3 miles to its junction with Cow Creek (tributary to Colorado River). Burnet topographic map.

Beech Creek.—Nacogdoches and Rusk counties; rises in the northern part of Nacogdoches County; flows northwesterly 8 miles; connects with East Shawnee Creek (tributary to Angelina and Neches rivers) in Rusk County near the Rusk-Nacogdoches county line.

Beech Creek.—Van Zandt County; rises about 2 miles south of Canton; flows northeasterly 19 miles into Sabine River in the northeastern part of the county.

Beecham Branch.—Montague County; small intermittent stream flowing into Mallard Creek (tributary to Denton Creek, thence through Elm Fork of the Trinity to Trinity River) about 1½ miles northeast of Denver. Montague topographic map.

Bee Cove Creek.—Lampasas County; rises near Mills-Lampasas county line; flows northeasterly 6 miles into Simms Creek (tributary through Lampasas and Little rivers to the Brazos) in northern part of county. Lampasas topographic map.

Bee Caves Creek.—Kerr County; rises south of Vix in central part of county; tributary to North Fork of Guadalupe River, and thus to Guadalupe River. Kerrville topographic map.

Beef Canyon.—Brewster County; rises 4½ miles east of Horseshoe Mesa in eastern part of county; flows northeasterly 11 miles into San Francisco Creek and thus to Rio Grande; intermittent. Bullis Gap topographic map.

Beef Creek.—Jasper County; a small stream flowing through northern part of county into Angelina River (tributary to the Neches).

Beehouse Creek.—Coryell County; rises 3 miles southeast of Evant in western part of county; flows southeasterly 20 miles into Cowhouse Creek (tributary to Leon River and thus through Little River to the Brazos) one-half mile north of Pidcoke. Lampasas and Gatesville topographic map.

Belknap Creek.—Montague County; formed 4 miles northwest of Stoneburg by union of West and Middle Belknap Creeks; flows northeasterly 12 miles into Red River (tributary to the Mississippi) about 4 miles north of Belcherville. Montague topographic map.

BELL BRANCH.—Ellis County; small stream flowing to Cottonwood Creek (tributary through Mountain Creek to West Fork of Trinity River, thence to the Trinity) in northwestern part of county. Fort Worth topographic map.

BELL BRANCH.—Erath County; rises 2 miles northwest of Dublin; flows easterly 7 miles into Green Creek (which discharges into Brazos River through Bosque River) in the southern part of county. Stephenville topographic map.

BELL CREEK.—Ellis County; small stream flowing through southwestern part of county into Pecan Creek, thence to Richland Creek and Trinity River.

BELL HOLLOW.—Sutton County; a small intermittent stream 6 miles long in the southeastern part of the county; flows through North Llano River into Llano River (tributary to the Colorado). Fort McKavett topographic map.

BELLS SLOUGH.—Cass County; about 4½ miles northwest of Alamo Mills in northeastern part of county; an old channel of Sulphur River (tributary to Red River, which discharges into the Mississippi). Texarkana topographic map.

BEN BRANCH.—Gonzales County; rises west of Moulton in northeastern part of county; flows into Peach Creek and thus to Guadalupe River; intermittent. Flatonia topographic map.

BEN FORT CREEK.—Grimes County; formed by union of several small streams in north central part of county; flows southwestward 7 miles into Navasota River (tributary to the Brazos).

BENS HOLE CREEK.—Brewster County; small intermittent stream 6 miles long flowing southwesterly into Terlingua Creek (tributary to Rio Grande) 10 miles north of Terlingua Abaja in southern part of county. Terlingua topographic map.

BENTS CREEK.—Hutchison County; small intermittent stream 3 miles long flowing southerly into Canadian River (tributary to Arkansas River and thus to the Mississippi) 11 miles northeast of Plemons in eastern part of county.

BENNETT CREEK.—Lampasas and Mills counties; rise 2 miles southeast of Goldthwaite in southeastern part of Mills County; flows southeasterly 23 miles into Lampasas River (tributary through Little River to the Brazos) in the extreme northern part of Lampasas County. San Saba and Lampasas topographic maps.

BENNETTS CREEK.—Jack County; flows into Martins Creek (tributary to West Fork of Trinity River and thus to the Trinity) in the northeastern part of the county.

BENJAMIN CREEK.—Comal County; in northern part of county; small intermittent tributary to Guadalupe River.

BERKLEY CREEK.—Donley and Hall counties; rises in southeastern part of Donley County; flows southeasterly into Prairie Dog Town Fork of Red River (tributary to Red River and thus to the Mississippi) about 4 miles west of Newlin in eastern part of Hall County.

BERRYS CREEK.—Erath County; a small stream flowing southeasterly 9 miles into Paluxy Creek (tributary to Brazos River) at Bluff Dale in northeastern part of county. Stephenville topographic map.

BERRY OR HICKORY CREEK.—Burleson County; rises 6 miles southeast of Caldwell; flows southeasterly 5 miles into Davidson Creek (tributary through Yegua Creek to Brazos River).

Berry Creek.—Williamson County; rises near Burnet-Williamson county line, 7 miles northwest of Florence in northwestern part of county; flows southeasterly 22 miles into San Gabriel River (tributary to Little River and thus to the Brazos) 4 miles northeast of Georgetown. Georgetown topographic map.

Bidais Creek.—Grimes, Madison, and Walker counties; rises near Iola in the northern part of Grimes County; flows circuitously northeastward 15 miles through Madison and Grimes counties to the northwestern corner of Walker County; then 19 miles along the boundary between Madison and Walker counties to a point north of Falba, where it enters Trinity River.

Big Aguja Canyon.—Jeff Davis County; rises near Black Mountain 10 miles northwest of Fort Davis, at an approximate altitude of 6,500 feet above sea level; flows northeasterly 12 miles, thence northerly 10 miles to its junction with Madero Canyon to form Toyah Creek (tributary to Pecos River and thus to Rio Grande). Principal tributary to Toyah Creek. Fort Davis topographic map.

Big Branch.—Stephens County; an intermittent stream rising 1 mile southwest of Gunsight and flowing northerly 9 miles into Gonzales Creek (tributary through Clear Fork of Brazos River to the Brazos) 7 miles south of Breckenridge. Breckenridge topographic map.

Big Boggy Creek.—Matagorda County; rises in the south central part of the county; flows southeasterly 12 miles into Matagorda Bay and thus to the Gulf of Mexico.

Big Blue Creek.—Dallam, Sherman, Moore, and Hutchinson counties; rises in southeastern part of Dallam County, crosses the southwestern corner of Sherman County, and flows southeasterly across Moore County to a point 6 miles northwest of Isom in southwestern part of Hutchinson County, where it enters Canadian River (tributary through the Arkansas to the Mississippi); length, 50 miles.

Big Brushy Creek.—Dewitt and Lavaca counties; rises near Yoakum in the northern part of Dewitt County; flows southeastward 5 miles through Dewitt County, then 18 miles through Lavaca County into Lavaca River tributary to Matagorda Bay and thus to Gulf of Mexico.

Big or Barkman Creek.—Bowie County; rises near Whaleys in northern part of county; flows easterly 25 miles to its intersection with the Texas-Arkansas boundary line at Carbon, thence southerly through Miller County, Arkansas into Red River (tributary to the Mississippi). New Boston and Texarkana topographic maps.

Big Creek.—Franklin County; rises about 6 miles southwest of Mount Vernon; flows northerly 11 miles into Whiteoak Bayou (tributary to Sulphur River, thence to Red River and the Mississippi).

Big Creek.—Fort Bend County; rises south of Rosenberg; flows southeasterly 25 miles into Brazos River in southeastern part of county.

Big Creek.—Falls and Limestone counties; rises 10 miles northwest of Groesbeck in southwestern part of Limestone County; flows southwestward into Brazos River near Highbank in southern part of Falls County.

Big Creek.—Hunt County; rises in northeastern part of county; flows southeasterly 4 miles into South Sulphur River (tributary to Sulphur River and thus through Red River to the Mississippi).

Big Creek.—San Jacinto and Liberty counties; rises near Cold Springs in the central part of San Jacinto County; flows southeasterly 20 miles through San Jacinto County, then 2 miles through Liberty County, joining Trinity River near its intersection with the north line of Liberty County.

BIG CREEK.—Brazos County; rises 2 miles northwest of Allen Farm in southern part of county; flows easterly 18 miles into Navasota River (tributary to the Brazos) 3 miles west of the town of Navasota; intermittent. Gay Hill and Navasota topographic maps.

BIG CREEK.—Jasper County; rises about 6 miles south of Jasper; flows southwesterly 11 miles into Neches River.

BIG CREEK.—Lee County; a small intermittent stream flowing southwestward 5 miles into Second Yegua Creek (tributary through Yegua Creek to Brazos River) west of Lexington. Bastrop topographic map.

BIG BEAR CREEK.—Tarrant and Dallas counties; rises about 3 miles west of Keller in Tarrant County; flows southeasterly 25 miles into West Fork of Trinity River (tributary to Trinity River) about 3 miles northeast of Grand Prairie, in western part of Dallas County. Fort Worth and Dallas topographic maps.

BIG CADDO CREEK.—Palo Pinto and Stephens counties; rises 5 miles north of Ranger in southeastern part of Stephens County; flows northeasterly 32 miles into Brazos River at the Horseshoe Bend in northwest corner of Palo Pinto County. Breckenridge topographic map.

BIG CEDAR CREEK.—Brazos and Robertson counties; rises near Franklin in central part of Robertson County; flows southeasterly 24 miles into Navasota River (tributary to the Brazos) east of Edge, about a mile north of Madison-Grimes county line.

BIG CANYON.—Brewster County; rises in southwestern part; flows northeasterly 4½ miles into Rio Grande; intermittent. Maravillas Canyon and Reagan Canyon topographic maps.

BIG CEDAR CREEK.—Stephens and Palo Pinto counties; rises 3 miles southwest of La Casa and 2 miles southeast of Steel Essy Mountain in southeastern part of Stephens County; flows northeasterly 37 miles into Brazos River at the Horseshoe Bend in northwest corner of Palo Pinto County, 5 miles east of Yanceyville. Breckenridge topographic map.

BIG COW CREEK.—Newton County; rises in northwestern corner of county; flows southeasterly 43 miles through the county into Sabine River about 5 miles south of Belgrade.

BIG CYPRESS CREEK.—Harris County; rises in western part of county near Waller-Harris county line; flows easterly 17 miles into Cypress Creek (tributary to Spring Creek, thence to San Jacinto River and thus through Galveston Bay to Gulf of Mexico); intermittent. Swanson, Cypress and Ashford topographic maps.

BIG CYPRESS BAYOU OR CREEK.—Hopkins, Franklin, Titus, Morris, Camp, Upshur, and Marion counties; rises in southeastern part of Hopkins County about 4 miles east of Carrols Prairie; flows southeasterly 10 miles into Caddo Lake (tributary to Red River and thus to the Mississippi) about 4 miles east of Jefferson in southern part of Marion County.

BIG CYPRESS CREEK.—Jasper and Newton counties; rises about 2 miles northeast of Bessmay in Jasper County; flows southeasterly 20 miles; enters Sabine River in Newton County at Deweyville.

BIG EDDY.—Harris County; 3½ miles west of Crosby; an arm of San Jacinto River; tributary to San Jacinto River and thus to the Gulf of Mexico; length, three-fourths of a mile. Harmaston and Crosby topographic maps.

BIG CYPRESS CREEK.—Tyler and Hardin counties; rises about 9 miles northwest of Woodville in Tyler County; flows southeasterly 32 miles into Alabama Creek (tributary to Neches River) about 4 miles east of Village Mills in Hardin County.

BIG ELM OR ELM CREEK.—McLennan, Bell, and Milam counties; rises at the town of Moody in southern part of McLennan County; flows southeasterly 55 miles into Little River (tributary to Brazos River) 2 miles northeast of Cameron in central part of Milam County. Temple and Taylor topographic maps.

BIG FIVEMILE CREEK.—Fayette and Gonzales counties; rises in the town of Flatonia; flows southwesterly 7 miles through Fayette County, then 4 miles through Gonzales County into Peach Creek (tributary to Guadalupe River). Flatonia topographic map.

BIG FOSSIL CREEK.—Tarrant County; rises about a mile north of Calef; flows southeasterly 16 miles into West Fork of Trinity River (tributary to the Trinity) about 5 miles northeast of Fort Worth, near center of the county. Fort Worth topographic map.

BIG GAP CREEK.—Donley and Collingsworth counties; rises in northeastern part of Donley County; flows southeasterly 7 miles into Salt Fork of Red River (tributary to Prairie Dog Town Fork of the Red and thus through Red River to the Mississippi) in Collingsworth County about 2 miles east of the western boundary of the county.

BIG GRAPE CREEK.—Kent, Garza, and Scurry counties; rises in northwest corner of Scurry County; flows northerly along Kent-Garza county line into Double Mountain Fork of Brazos River (tributary to the Brazos) northwest of Polar.

BIG HILL BAYOU.—Jefferson County; rises 8 miles southwest of Port Arthur in eastern part of the county; flows easterly and northerly 8 miles into Taylors Bayou (tributary through Sabine Lake to Gulf of Mexico) 5 miles west of Port Arthur; tidal.

BIG LAKE.—Bowie County; about 6 miles north of Leary in northeastern part of county; inlet, Collums Spring Branch; outlet, Red River (tributary to Mississippi River); formerly a channel of Red River.

BIG ISLAND SLOUGH.—Harris County; rises 4 miles northwest of LaPorte; flows southerly 7 miles into Middle Bayou (tributary to Clear Lake and thus to Gulf of Mexico); partially intermittent. La Porte and Seabrook topographic maps.

BIG LAKE (MCFARLAND LAKE).—Bowie County; about 4 miles south of Maud in southern part of county; formed by an old channel of Sulphur River, which discharges into the Mississippi through Red River. New Boston topographic map.

BIG LAKE.—Cass County; about 5½ miles west of Alamo Mills in northeastern part of county; formed by an old channel of Sulphur River (tributary through Red River to the Mississippi). Texarkana topographic map.

BIG LUCY LAKE.—Lampasas County; rises 4 miles west of Ogle station in southern part of county; flows southeasterly to a point about 2 miles south of Grundyville where it enters Lampasas River (tributary to Little River and thus to the Brazos). Lampasas topographic map.

BIG MUSTANG CREEK.—Red River County; rises near Lamar-Red River county line in southwestern part of county; flows southeasterly 16 miles into Sulphur River and thus through Red River to the Mississippi.

BIG MOUNTAIN CREEK.—Mills and Comanche counties; a stream flowing northeasterly 13 miles into Little Mountain Creek (tributary through South Leon Creek to Leon River, thence through Little River to the Brazos) 3 miles southwest of Fleming. Brownwood topographic map.

BIG BRANCH.—Stephens County; small intermittent stream flowing westerly 4 miles into Gonzales Creek (tributary to Clear Fork of Brazos River and thus to the Brazos) north of Breckenridge. Breckenridge topographic map.

Bitter Creek.—DeWitt County; small tributary to Sandies Creek and thus to Guadalupe River in western part of county.

Bitter Creek.—King County; a small stream rising in northeastern part of county and flowing easterly 7 miles into Ox Yoke Creek (tributary to South Wichita River and thus through Wichita and Red rivers to the Mississippi).

Bitter Branch.—Fayette County; southeast of Cistern in the western part of the county; small intermittent stream 3 miles in length flowing into Live Oak Creek (tributary to Buckner Creek and thus to Colorado River). Flatonia topographic map.

Bitter Creek.—Jones and Taylor counties; rises 4 miles southeast of Trent in northwestern part of Taylor County; flows northeasterly 23 miles into Clear Fork of Brazos River (tributary to the Brazos) 3 miles southeast of Nugent in northern part of Jones County. Sweetwater, Roby, and Anson topographic maps.

Bitter Creek.—Donley and Hall counties; rises in southern part of Donley County; flows southwesterly 3½ miles into Mulberry Creek (tributary to Prairie Dog Town Fork of Red River and thus through Red River to the Mississippi) in northwestern part of Hall County.

Bitter Creek.—Nolan County; rises at Nolan; flows northerly 21 miles into Sweetwater Creek (tributary through Clear Fork of Brazos River to the Brazos) 1 mile west of Eskota; intermittent. Sweetwater and Roby topographic maps.

Bitter Creek.—King County; rises in northeastern part of county; flows southerly 6 miles into Ox Yoke Creek (tributary through South Wichita River to Wichita River and thus through Red River to the Mississippi).

Blackland Gully.—Harris County; rises 6½ miles northeast of Moonshine Hill; flows northeasterly 1½ miles into East Fork of San Jacinto River and thus to Gulf of Mexico, passing through San Jacinto, Trinity and Galveston bays; intermittent. Moonshine Hill topographic map.

Bitter Lake Creek.—Motley County; flows northerly 4 miles through northeastern part of county into Pease River (tributary to Red River, which discharges into the Mississippi) about 2 miles northwest of Northfield.

Blacks Bayou.—Jefferson County; small tidal stream about a mile northeast of Nederland flowing into Neches River.

Black Bayou.—Cass County, Tex. and Caddo Parish, La.; rises in northern part of Cass County about 6 miles northwest of Lanark; flows southeasterly 45 miles crossing the State boundary about 1 mile south of the intersection of Arkansas, Louisiana and Texas boundaries; enters Soda Lake (tributary to Red River and thus to the Mississippi) in Caddo Parish, La. Atlanta topographic map.

Black Cypress Bayou.—Morris, Cass, and Marion counties; rises 4 miles northeast of Daingerfield in eastern part of Morris County; flows southeasterly about 40 miles into Big Cypress Bayou (tributary to Caddo Lake, which discharges into Mississippi River through the Red) 3½ miles east of Jefferson in southern part of Marion County. Daingerfield topographic map.

Black Creek.—Cass County; an intermittent stream flowing northeasterly 8½ miles into Overcup Slough (tributary to Sulphur River and thus through Red River to the Mississippi) about 4 miles northwest of Douglasville. Linden topographic map.

Black Creek.—Medina and Frio counties; rises in the east central part of Medina County; flows southward 15 miles through Medina County, then 17 miles through Frio County into San Miguel Creek (then to the Nueces through Frio River); length, 32 miles.

BLACK CREEK.—Tyler County; small stream south of Warren in southern part of county; joins Wood Creek (tributary to Alabama Creek, and thus to Neches River) near southern county line.

BLACK FORK OF PRAIRIE CREEK.—Smith County; rises at Tyler; flows westerly 10 miles into Prairie Creek (tributary to Neches River).

BLACK HILL BRANCH.—Bexar County; near Atascosa in southwestern part of county; an intermittent tributary through Elm Creek to Medina River, and thus through San Antonio River to the Guadalupe. San Antonio topographic map.

BLACK HILLS CREEK.—Presidio County; small stream in southern part of county; flows southwesterly to its junction with Torneros Creek, thence one mile to Rio Grande, 7 miles southwest of Presidio; length, 18 miles; intermittent. Shafter topographic map.

BLACK HOLLOW.—Cooke County; small intermittent stream rising about 3 miles southeast of Marysville in northern part of county and flowing into South Fish Creek (tributary to Fish Creek and thus through Red River to the Mississippi). Gainesville topographic map.

BLACK JACK CREEK.—Fayette County; east of Muldoon in central part of the county; an intermittent tributary through Pinoak Creek to Buckner Creek and thus to Colorado River; length, 3 miles. Flatonia topographic map.

BLACK LAKE.—Gray County; western part; when overflowing joins North Fork of Red River (tributary to Red River and thus to the Mississippi); area about one-half square mile; prairie lake.

BLACK SPRING BRANCH.—Erath County; an intermittent stream 3 miles long flowing northeasterly into Little Green Creek (tributary to Green Creek and thus through Bosque River to the Brazos) south of Alexander in southern part of county. Stephenville topographic map.

BLACK LAKE.—Harris County; in the eastern part of county 3 miles southwest of Crosby; small. Crosby topographic map.

BLACKTAIL CREEK.—Briscoe and Armstrong counties; rises in northern part of Briscoe County; flows northerly 3 miles into Prairie Dog Town Fork of Red River (tributary to Red River, which discharges into the Mississippi) near the northern line of the county.

BLAKE CREEK.—Wise County; small tributary to Denton Creek (which discharges into Trinity River through Elm Fork of the Trinity) in the southeastern part of the county.

BLANCO CREEK.—Goliad, Karnes, and Bee counties; rises at a point near to the corner common to Goliad, Karnes, and Bee counties; flows southeastward 28 miles along the boundary of Goliad and Bee counties to its junction with El Sarco River (thence to Gulf of Mexico through Rio de la Mission and Copano bays) just above Blanconia.

BLANCO RIVER.—Kendall, Blanco, and Hays counties; rises east of Bankersmith in the northeastern part of Kendall County; flows southeasterly 7 miles through Kendall County, 19 miles through the southern part of Blanco County, then 38 miles through Hays County where it joins San Marcos River (tributary to Guadalupe River) about 2 miles southeast of San Marcos, southeastern part of Hays County. Fredericksburg, Blanco, Austin, and San Marcos topographic maps.

BLANCO RIVER.—Uvalde County; rises 5 miles northeast of Concan, in the northern part of the county; flows southerly 38 miles into Sabinal River (thence to the Nueces through Frio River) in southeast corner of county. Uvalde topographic map.

Blanco River, Cypress Fork of.—Hays County; flows southerly 20 miles south of Mount Sharp into Blanco River (tributary to San Marcos River and thus to the Guadalupe) in western part of county. Blanco topographic map.

Bland Creek.—Red River County; rises about 2 miles southeast of Bagwell; flows southwesterly 6 miles into Bruton Creek (tributary to Guest Creek and thus through Cuthand Creek, Sulphur and Red rivers to the Mississippi).

Blanket Creek.—Comanche, Brown, and Mills counties; rises 10 miles west of Comanche in southwestern part of Comanche County; flows southerly 30 miles into Pecan Bayou (tributary to the Colorado) 6 miles southwest of Mullen. Brownwood topographic map.

Bliss Branch.—Leon County; rises about 4 miles northeast of Jewett; flows northeasterly 11 miles into Buffalo Creek (tributary to upper Keechi Creek, thence to Trinity River) about 2 miles southwest of Keechi.

Blocker Creek.—Cooke County; joins Clear Creek (tributary to Elm Fork of Trinity River, and thus to the Trinity) in southwestern part of county; intermittent. Gainesville topographic map.

Block Creek.—Kendall County; rises in northwestern part of county; flows southerly into Guadalupe River. Fredericksburg topographic map.

Bloomfield Branch.—Stephens County; small intermittent stream flowing into Clear Fork of Brazos River and thus to the Brazos in northern part of county northwest of Crystal Falls. Breckenridge topographic map.

Blue Branch.—Bastrop County; small intermittent stream 3 miles long flowing into Colorado River 3 miles southeast of Bastrop in the central part of the county. Bastrop topographic map.

Blue Branch.—Coryell County; small stream flowing northeasterly 5 miles into Leon River (tributary through Little River to the Brazos) 4 miles northwest of Gatesville in central part of county. Gatesville topographic map.

Blue Branch.—Lee County; rises at Foot of Yegua Knobs; flows northerly 5 miles into Second Yegua Creek (tributary through Yegua Creek to Brazos River) in western part of county. Bastrop topographic map.

Blue Creek.—Brewster County; an intermittent stream in southern part of the county; rises on the western slopes of Chisos Mountains; flows southwestward 17 miles into Rio Grande 8 miles southeast of Terlingua Abaja. Terlingua and Chisos Mountains topographic maps.

Blue Creek.—Guadalupe and Wilson counties; rises in the southwestern part Guadalupe County; flows southwesterly 10 miles through Guadalupe County, then 2 miles through Wilson County where it joins Rio Cibolo (tributary to San Antonio River and thus to the Guadalupe) 5 miles north of Sutherland Springs.

Blue Creek.—Wharton and Matagorda counties; small tributary which rises near El Campo in southern part of Wharton County; unites with Colorado River in northern part of Matagorda County; length, 13 miles.

Bluff Canyon.—Val Verde County; an intermittent stream in the eastern part of county; flows westward into Dry Devil's River (tributary to Devil's River and thus to Rio Grande).

Bluff Creek.—Briscoe and Hall counties; rises in the eastern part of Briscoe County; flows easterly 5 miles into Little Red River (tributary to Prairie Dog Town Fork of Red River, which discharges into the Mississippi through Red River) at its intersection with west line of Hall County.

Bluff Creek.—Collin, Rockwall, and Hunt counties; rises about 3 miles southwest of Nevada in Collin County, flows southeasterly 18 miles into South Fork of Sabine River (thence to Sabine River) in Hunt County, 4 miles south of Quinlan.

Bluff Creek.—Coleman County; a stream 7 miles long in the northwestern part of the county; flows through Jim Ned Creek into Pecan Bayou and thus to Colorado River. Ballinger and Coleman topographic maps.

Bluff Creek.—Edwards County; a small intermittent tributary flowing northwesterly 5 miles into West Nueces River and thus to the Nueces in the southern part of the county. Nueces topographic map.

Bluff Creek.—Hopkins County; northeastern part; small tributary to Crosstimber Creek (which discharges into Sulphur River through Whiteoak Bayou, thence through Red River to the Mississippi).

Bluff Creek.—Lee and Bastrop counties; rises near Paige on Houston & Texas Central Railroad in eastern part of Bastrop County; flows northeasterly 7 miles into Third Yegua Creek (tributary through Second Yegua Creek to Yegua Creek and thus to the Brazos) in central part of Lee County. Bastrop topographic map.

Bluff Creek.—McCulloch County; a stream 7 miles long flowing through the northern part of the county into Colorado River. Brady topographic map.

Bluff Creek.—McLennan and Coryell counties; rises 2 miles southwest of Coryell City; flows easterly 12 miles into Middle Bosque River (tributary through South Bosque and Bosque rivers to the Brazos) 2 miles northwest of Crawford in western part of McLennan County. Meridian and Waco topographic maps.

Bluff Creek.—Knox County; small stream flowing to a point northwest of Truscott in northern part of county, where it enters North Wichita River, thence to Wichita River and thus through the Red to Mississsippi River.

Bluff Creek.—Motley County; rises in the eastern part; flows easterly 6½ miles into South Pease River (tributary to Middle Pease River, thence through Pease to Red River and thus to the Mississippi) about 1 mile from the eastern border to the county.

Bluff Creek.—Shackelford County; rises 8 miles west of Albany; flows northwesterly 12 miles into Clear Fork of Brazos River (tributary to the Brazos) in northwestern part of the county. Anson and Albany topographic maps.

Bluff Creek, East Fork.—Wilbarger and Wichita counties; rises in western part of Wilbarger County, 2½ miles west of Electra; flows southerly, meandering across Wilbarger-Wichita county line into Beavers Creek, and thus to Wichita River; intermittent. Electra topographic map.

Bluff Creek, West Fork.—Wilbarger County; rises in northeastern part 4 miles southeast of Electra; flows southeasterly into Bluff Creek, thence to Beavers Creek, tributary to Wichita River; intermittent. Electra topographic map.

Bluff Creek.—Taylor and Runnels counties; rises 5 miles north of Mount Moro in southwestern part of Taylor County; flows southeastward 28 miles into Elm Creek (tributary to the Colorado) 5 miles northeast of Runnels in the central part of Runnels County. Sweetwater, Abilene, and Ballinger topographic maps.

Blundell Creek.—Franklin and Titus counties; rises about 3 miles south of Mount Vernon in eastern part of Franklin County; flows southeastward 13 miles into Big Cypress Bayou (tributary to Caddo Lake and thus through Red River to the Mississippi) in southwestern part of Titus County.

Board Branch.—Eastland, Stephens, and Shakelford counties; rises in the northwest corner of Eastland County; flows northerly 4 miles into Battle Creek (tributary to Bear Creek and thus through Sandy, Hubbard, and Gonzales creeks to Clear Fork of Brazos River and thence to the Brazos) west of Indian Knoll. Albany topographic map.

Boardinghouse Creek.—Bowie County; a small intermittent stream joining Sulphur River (tributary to Red River, which discharges into the Mississippi) about one-half mile west of Draper in southeastern corner of county. Texarkana topographic map.

Boartree Creek.—Montague County; small intermittent stream flowing into Red River (tributary to the Mississippi) west of Illinois Bend in northeastern part of county. Montague topographic map.

Bob Creek.—Stonewall and King counties; a small stream flowing southerly 5 miles into Salt Fork of Brazos River (tributary to Brazos River) at mouth of Dove Creek.

Boss Creek.—Dewitt County; a small tributary to Guadalupe River in southeastern part of county 7 miles southeast of Cuero.

Boss or Blackberry Creek.—Archer County; rises in northwestern part of county; flows northerly 4 miles into Wichita River (tributary to Red River and thus to the Mississippi), near the north line of Archer County.

Bodano Bayou.—Angelina County; a stream 9 miles long flowing southwesterly into Neches River southwest of Pollok in the northwestern part of the county.

Bofecillos Canyon.—Presidio County; rises in the southern part of county; flows westerly 8 miles where it empties into Rio Grande 4 miles northwest of Polvo. Polvo topographic map.

Boggy Branch.—Johnson and Ellis counties; small stream flowing 6 miles along the boundary of Johnson and Ellis counties into Onion Creek, thence to North Fork of Pecan, Pecan, and Richland creeks, and Trinity River. Cleburne topographic map.

Bog or Hog Creek.—Upshur County; southeastern part; flows northeastward 6 miles into Little Cypress Creek (tributary to Caddo Lake, which discharges into Mississippi River through the Red).

Boggy Creek.—Brazos County; an intermittent stream flowing southerly in southern part of county; joins Brazos River 1 mile north of Clay Lake. Gay Hill topographic map.

Boggy Creek.—Floyd and Motley counties; rises in eastern part of Floyd County about 1 mile from the eastern boundary of the county; flows easterly 6½ miles into Middle Pease River (tributary to Pease River and thus through Red River to the Mississippi) about 9 miles northwest of Matador in the western part of Motley County.

Boggy Creek.—Jasper County; rises about 5 miles south of the center of the county; flows southwesterly 9 miles into Neches River.

Boggy Creek.—Lavaca County; small intermittent tributary to Liveoak Creek (thence to Gulf of Mexico through Lavaca River and Matagorda Bay) in northwestern corner of county; flows southwesterly 5 miles. Flatonia topographic map.

Boggy Creek.—Lavaca County; a small stream flowing easterly into Lavaca River (tributary to Gulf of Mexico through Matagorda Bay) 4 miles northwest of the town of Hallettsville; length, 2 miles.

Boggy Creek.—Leon County; rises about 2 miles northeast of Flynn; flows easterly 23 miles into Trinity River at Commerce in southeastern corner of county.

Boggy Creek.—Morris County; rises about 4 miles northwest of Omaha in northern part of county; flows southerly 23 miles into Big Cypress Bayou (tributary to Caddo Lake and thus to Red and Mississippi rivers) about 8 miles south of Daingerfield.

BOGGY CREEK.—Red River County; rises about 3 miles northwest of Clarksville near center of county; flows southeasterly 12 miles into Cuthand Creek (tributary to Sulphur River, which discharges into the Mississippi through Red River).

BOGGY CREEK.—Travis County; rises 4½ miles northeast of Austin; flows southeasterly 7 miles into Colorado River; intermittent. Austin topographic map.

BOGGY CREEK.—Williamson County; flows northerly 6 miles into Brushy Creek (tributary to San Gabriel River and thus through Little River to the Brazos) 6 miles southwest of Thorndale. Bastrop and Taylor topographic maps.

BOGGY CREEK.—Williamson County; small intermittent stream flowing easterly 5 miles into Brushy Creek (tributary to San Gabriel River, which discharges into Brazos River through Little River) 2 miles northeast of Coupland. Bastrop and Taylor topographic maps.

BOGGY CREEK.—Wilbarger County; rises in south central part of county; flows southeasterly 7 miles into Beaver Creek (tributary to Wichita River and thus through the Red to Mississippi river).

BOGGY CREEK.—Wise County; rises south of Balsora; flows easterly 13 miles into West Fork of Trinity River (tributary to Trinity River) about 3 miles northeast of Paradise.

BOGGY CREEK.—Gonzales County; east of Waelder; small intermittent stream flowing into Baldridge Creek and thus through Peach Creek to Guadalupe River. Flatonia topographic map.

BOGGY CREEK.—Young and Throckmorton counties; rises in north central part of Throckmorton County; flows southeasterly 23 miles into the Brazos, 3 miles northwest of Proffitt in western part of Young County.

BOIS D'ARC CREEK.—Grayson, Fannin, and Lamar counties; rises about a mile from the Grayson-Fannin county line and 6 miles southwest of Savoy in eastern part of Grayson County; flows southeasterly 11 miles, then northeasterly 40 miles into Red River (tributary to the Mississippi) near Direct and northern Lamar-Fannin county line.

BONITA CREEK.—Potter County; rises in eastern part of county; flows northwesterly 10 miles into Canadian River (tributary to Arkansas River and thus to the Mississippi).

B. O. BRANCH.—Fayette County; in the western part of the county; a small intermittent stream flowing south of Stellar 3 miles into Buckner Creek (tributary to Colorado River). Flatonia topographic map.

BOON SLOUGH.—Uvalde County; rises 8 miles north of Uvalde; flows southerly 6 miles to its junction with Cooks Slough (tributary to Nueces River through Leona and Frio rivers) at Uvalde station. Uvalde topographic map.

BOON CREEK.—Leon County; rises about 2 miles southwest of Oakwoods; flows southeasterly 9 miles into Trinity River about a mile north of Navarro.

BOON CREEK, SOUTHWEST FORK OF.—Leon County; small tributary to Boon Creek (which discharges into Trinity River) about 2 miles west of Navarro.

BOOTHE CREEK.—Bowie County; rises about 6 miles southwest of DeKalb in southwestern part of county; flows southerly 11 miles into Sulphur River (tributary to Red River and thus to the Mississippi) about 3 miles east of southwestern corner of county.

BORDEN CREEK.—Bastrop and Fayette counties; rises near Rosanky in the southern part of Bastrop County; flows northeasterly 15 miles into Colorado River in the western part of Fayette County, 2½ miles east of West Point. Flatonia topographic map.

Boregas Creek.—Sabine County; rises 5 miles northwest of Milam; flows southeasterly 10 miles into Palo Gaucho Bayou (tributary to Sabine River) about 3 miles northeast of Milam.

Boregas Creek, West Fork of.—Sabine County; rises about 5 miles northwest of Milam; flows southeasterly 6 miles into Boregas Creek (tributary through Palo Gaucho Bayou to Sabine River) at Milam.

Borrego Creek.—Wilson and Atascosa counties; rises in the western part of Wilson County; flows southeastward and southward 10 miles through Wilson County, then 25 miles through Atascosa County into Atascosa River (tributary to Frio and Nueces rivers) at Campbellton.

Bosque River.—Erath, Hamilton, Bosque, and McLennan counties; rises 5 miles south of Wyleyville in northern part of Erath County; flows generally southeasterly 115 miles through the towns of Stephenville, Hico, Iredell, and Meridian into Brazos River 3 miles northwest of Waco in the central part of McLennan County. Stephenville, Hamilton, Meridian, and Waco topographic maps.

Bourland or Drennan Creek.—Fannin and Lamar counties; rises about 1 mile southeast of Honey Grove in southeastern part of Fannin County; flows southeasterly 9 miles into North Sulphur River (tributary to Sulphur River, which discharges into the Mississippi through Red River) in southwestern part of Lamar County at the southern boundary of Lamar County.

Bow Creek.—Throckmorton County; a stream flowing northerly 5 miles into Millers Creek (tributary to the Brazos) in northwestern part of county.

Bowles Creek.—Rusk and Cherokee counties; rises about 2 miles east of Overton in Rusk County; flows southwesterly 21 miles; empties into Striker Creek (tributary to Angelina River and thus to the Neches) in southeastern part of Cherokee County.

Bowman Creek.—Cass County; rises about 4 miles north of the town of Linden in central part of county; flows into Colley Creek (tributary through Frazier Creek to Caddo Lake and thus through Red River to the Mississippi); very small; intermittent.

Bowries or Ninemile Creek.—Menard County; a stream 12 miles long rising in the central part of the county and flowing into the San Saba (tributary to Colorado River). Eden topographic map.

Bowling Green Creek.—Jackson and Calhoun counties; rises in the southern part of Jackson County; flows southerly 18 miles through Jackson and Calhoun counties into Kellers Bay, thence to Matagorda Bay and Gulf of Mexico.

Box Creek.—Anderson County; flows southwesterly 14 miles into Trinity River, west of Elkhart in southwestern part of county.

Brays Bayou.—Harris County; rises in the southern part of the county; flows northeasterly 26 miles into Ship Channel (Buffalo Bayou) (thus to Galveston Bay and Gulf of Mexico) about 1½ miles below "Turning Basin"; tidal stream for about 2 miles in its lower course. Alief, Bellaire, and Park Place topographic maps.

Braden Branch.—Montague County; joins Denton Creek (which discharges into Trinity River through the Elm Fork of the Trinity) southwest of Forestburg in southern part of county. Montague topographic map.

Bradshaw Branch.—Eastland and Brown counties; rises in southeastern part of Eastland County near Rising Star; flows southeasterly and southwesterly 12 miles into Hog Creek (tributary to Pecan Bayou and thus to Colorado River); partially intermittent. Eastland, Brownwood, and Coleman topographic maps.

Brady Creek.—Concho, McCulloch, and San Saba counties; rises 14 miles southwest of Eden in the southwestern part of Concho County at an approximate altitude of 2,300 feet above sea level; flows easterly 30 miles through Concho County, 37 miles through McCulloch County, then 10 miles through San Saba County into San Saba River (tributary to the Colorado) 10 miles southwest of Richland Springs. San Angelo, Eden, Brady, and San Saba topographic maps. (See San Saba River.)

Brazos River, Clear Fork of.—Young, Stephens, Shackelford, Throckmorton, Jones, and Fisher counties; one of the principal tributaries to Brazos River; rises 12 miles west of Roby in western part of Fisher County; flows northeasterly 180 miles into Brazos River 12 miles southwest of Graham in southern part of Young County; drainage area, 5,670 square miles; gaging station near Eliasville, about 6 miles above mouth of river. Roby, Anson, Albany, and Breckenridge topographic maps. (See Brazos River.)

Brazos River.—One of the principal streams of the State; having the greatest discharge and being the longest of any stream in the State; rises in Roosevelt, Curry, and Quay counties, N. Mex.; headwater streams, Clear Fork, Salt Fork, and Double Mountain Fork of Brazos River; the Double Mountain Fork and Salt Fork unite in notheastern part of Stonewall County, about 470 miles above its mouth, to form the main stream; flows southeastward through the lower "Panhandle" and central part of the State of Texas into the Gulf of Mexico at Quintana, east of the towns of Velasco and Freeport, in Brazoria County; length, approximately 840 miles; drainage area, 41,700 square miles, of which 600 square miles are in New Mexico; important tributaries, other than headwater streams, are Navasota, Yegua, Little Brazos, Little, and Bosque rivers. Principal towns along the main stream are Velasco, Freeport, Richmond, Waco, Glenrose, Graham, and Seymour.

Rice irrigation is carried on extensively in the lower valley, but on account of the erratic flow in the upper catchment only scattered tracts are irrigated.

Several small dams have been constructed for power development on the main stream and tributaries, but only small amounts of power are generated. A system of locks and dams has been constructed on the river by the United States Government, for the purpose of making it navigable below Waco. Gaging stations at College Station, Waco, Brazos, and Graham, on the main stream; Eliasville, on the Clear Fork; and Cameron, on Little River. Gaging station was maintained at Richmond, 1903 to 1906. Temple, Waco, Clebourne, Granbury, Weatherford, Palo Pinto, and Breckinridge topographic maps. See second report of Texas board of water engineers for list of certified filings for appropriation of water from this stream.

Brewster Creek.—Bell County; rises in northern part of the county 6 miles southwest of Moody; flows southeasterly 3 miles into Stampede Creek (tributary to Leon River); partially intermittent. Temple topographic map.

Brewster Creek.—Cooke County; a small intermittent stream flowing into Bearhead Creek (tributary to Fish Creek and thus through Red River to the Mississippi) southeast of Three Mounds. Gainesville topographic map.

Briar Branch.—Burleson and Milam counties; rises 6 miles southeast of Rockdale, in southern part of Milam County; flows southwestward 8 miles into Firt Yegua Creek (tributary through Yegua Creek to Brazoz River) near Milam-Burleson county line.

Briar Branch.—Harris County; rises three-fourths of a mile east of Hillendahl; flows easterly 2½ miles into Spring Branch (tributary to Buffalo Bayou and thus to Gulf of Mexico); intermittent. Hillendahl and Houston Heights topographic maps.

Briar Branch.—Wise, Parker, and Tarrant counties; a small stream flowing into West Fork of Trinity River (tributary to Trinity River) near the towns of Briar and New Hope and the corner common to Wise, Parker, and Tarrant counties. Weatherford topographic map.

Briar Creek.—Young County; a stream flowing southwesterly 5 miles into Flint Creek (tributary to Salt Creek and thus to Brazos River) 4 miles north of Graham.

Briar Creek.—Navarro County; small stream flowing into Richland Creek (tributary to Trinity River), in central part of county.

Brick House Gully.—Harris County; small stream in central part of county; flows easterly 6½ miles into Whiteoak Bayou (thence to Buffalo Bayou, Galveston Bay, and Gulf of Mexico). 1 mile southeast of Rosslyn. Hillendahl and Houston Heights topographic maps.

Bridge Creek.—Burleson County; a small intermittent stream flowing southeasterly 6 miles into Yegua Creek (tributary to Brazos River), in southeastern part of county. Gay Hill topographic map.

Bridge Creek.—Kaufman and Henderson counties; rises in southwestern part of Kaufman County near county line; flows southerly 8 miles into Trinity River near Buffalo, in Henderson County.

Bridge Creek.—Sabine County; rises about 5 miles west of Hemphill; flows southeasterly 5 miles into Housing Bayou (tributary to Sabine River) about 3 miles southwest of Hemphill.

Brier Creek.—Grayson County; a small intermittent stream flowing into Red River (tributary to the Mississippi) in extreme northwestern part of county. Denison topographic map.

Brindle Creek.—Brewster County; rises in the eastern part; flows southeasterly through Brindle Canyon into Maxen Canyon (tributary to San Francisco Creek and thence to Rio Grande); intermittent. Bullis Gap and Indian Wells topographic maps.

Brier Creek.—Montague County; an intermittent stream flowing into Big Sandy Creek (tributary to West Fork of Trinity River and thus to the Trinity) southwest of Bowie in the southwestern part of county. Montague topographic map.

Britton Canyon.—Terrell County; rises in southwestern part about 2 miles northwest of Loma Vista; flows southwesterly 6½ miles into Rio Grande; intermittent. Dryden Crossing topographic map.

Brockman Branch.—Dallas County; rises about 5 miles west of Richardson; flows southwesterly 9 miles into Elm Fork of Trinity River (tributary to Trinity River) about 2 miles south of Letot. Dallas topographic map.

Brooks Creek.—Wise and Denton counties; a stream flowing to a point east of the town of Decatur, where it enters Olivers Creek (tributary to Denton Creek, thence to Elm Fork of Trinity River and the Trinity).

Brooks or Lick Creek.—Bowie County; rises about 3 miles northwest of Sims; flows southeasterly 13 miles into Anderson Creek (tributary to Sulphur River and thus through Red River to the Mississippi) about one-half mile north of mouth of Anderson Creek in southern part of county. New Boston topographic map.

Brougham or Blairs Creek.—Franklin County; rises in southwestern part of county; flows southeasterly 4 miles into Big Cypress Creek (tributary to Caddo Lake, which discharges into the Mississippi through Red River.)

Brown Creek.—Cass County; rises about 1½ miles southeast of Munz; flows northeasterly 6 miles into Powell Creek (tributary to Sulphur River, which discharges into the Mississippi through Red River) 2½ miles northwest of Douglasville. Linden topographic map.

Brown Creek.—Coryell County; a southerly flowing stream 7 miles long joining Cowhouse Creek (tributary to Leon River and thus through Little River to the Brazos) in the southern part of county west of New Sugar Loaf. Gatesville topographic map.

Brown Branch.—Coryell County; rises at Jackson Knob north of Killeen; flows northward 4 miles to Cowhouse Creek and thus through Leon and Little Rivers to the Brazos. Gatesville topographic map.

Brown Creek.—Mills County; a stream flowing north of Goldthwaite in the north central part of the county into Pecan Bayou and thus to the Colorado River; length, 15 miles. Brownwood and San Saba topographic maps.

Browns or Bitter Creek.—Young and Archer counties; rises in southwestern part of Archer County; flows southwesterly 8 miles into Brazos River near Spring Creek in northwestern part of Young County.

Brown Lake.—Donley County; 2½ miles northwest of Lelia; no outlet; very small; prairie lake.

Brush Creek.—Motley County; rises in eastern part of county; flows easterly 3 miles into Middle Pease River (tributary to Pease River and thus through the Red to Mississippi River) about 1½ miles north of Teepee City.

Brush Creek.—Colorado County; small tributary to Colorado River in the western part of the county; length, 3 miles.

Brushy Bayou.—Rockwall and Kaufman counties; rises near Chisholm in southern part of Rockwall County; flows southerly 21 miles into Cedar Creek (tributary to Trinity River) about 3 miles southwest of Kaufman in Kaufman County.

Brushy Creek.—Anderson County; small stream in the northeastern part of county flowing southeasterly 11 miles into Neches River about 1½ miles north of the International & Great Northern Railway bridge.

Brushy Creek.—Angelina County; rises about 2 miles south of Marion; flows southeasterly 6 miles into Angelina River (tributary to Neches River).

Brushy Creek.—Bastrop County; tributary through Sandy and Walnut creeks to Colorado River, in the south central part of county; length, 7 miles. Flatonia topographic map.

Brushy Creek.—Brazos County; rises about 5 miles north of Bryan in northern part of county; flows southeasterly 16 miles into Navasota River (tributary to Brazos River).

Brushy Creek.—Caldwell and Hays counties; rises about 3 miles east of Buda; flows southeasterly 8 miles through Hays County; then 3 miles through Caldwell County into Plum Creek (tributary to San Marcos and Guadalupe Rivers) about 3 miles east of Uhland. Austin and San Marcos topographic maps.

Brushy Creek.—Coke County; rises in the northeastern part of the county; flows 9 miles into Oak Creek and thus to the Colorado. Sweetwater topographic map.

Brushy Elm Creek.—Cooke County; rises 2 miles south of Tyler Bluff; flows southeasterly 14 miles into Elm Fork of Trinity River (tributary to Trinity River) about 2 miles southeast of Myra. Gainesville topographic map.

Brushy Creek.—Cooke and Grayson counties; rises about 2 miles south of Dexter in eastern part of Cooke County; flows easterly 11 miles into Mineral Creek (tributary to Red River and thus to the Mississippi) 3½ miles north of Steedman in northwestern part of Grayson County. Denison topographic map.

BRUSHY CREEK.—Delta County; formed about 5 miles east of Cooper in east central part of county by union of East and West Brushy creeks; flows southeasterly 3 miles into South Sulphur River (tributary to Sulphur River and thus through Red River to the Mississippi).

BRUSHY CREEK.—Donley and Hall counties; rises in southwestern part of Donley County; flows southerly 8 miles into Mulberry Creek (tributary to Prairie Dog Town Fork of Red River and thus through Red River to the Mississippi) in northwestern part of Hall County.

BRUSHY CREEK.—Fannin County; small stream flowing into Bois d 'arc Creek (tributary to Red River and thus to the Mississippi) in southwestern part of county.

BRUSHY CREEK.—Fannin County; rises about 4 miles southeast of Dodd City in southeastern part of county; flows southerly 6 miles into North Sulphur River, thence to sulphur River, and thus through Red River to the Mississippi.

BRUSHY CREEK.—Guadalupe County; rises in the Mill Creek Hills; flows easterly 10 miles into San Marcos River (tributary to the Guadalupe) 2 miles southeast of Prairie Lea. San Marcos topographic map.

BRUSHY OR SUBLETTS CREEK.—Ellis County; small stream flowing to Red Oak Creek (tributary to the Trinity) in the northeastern part of county. Dallas topographic map.

BRUSHY CREEK.—Fannin County; rises 1½ miles north of Savoy in northwestern part of county; flows northeasterly 5 miles into Red River (tributary to the Mississippi).

BRUSHY CREEK.—Grimes, Waller, and Montgomery counties; rises in southern part of Grimes County; flows southeasterly 4 miles through Grimes County, 13 miles through Waller County, then 3 miles through Montgomery County into Spring Creek (tributary to West San Jacinto River, then through San Jacinto River to the Gulf of Mexico).

BRUSHY CREEK.—Jackson County; rises in the northwestern part of county; flows southeasterly 13 miles into Sandy Creek, and thus to Navidad and Lavaca Rivers, thence to Matagorda Bay and Gulf of Mexico near Ganado.

BRUSHY CREEK.—Karnes County; in northern part of county; small tributary to Elm Fork of Sandies Creek (thence to Sandies Creek and Guadalupe River).

BRUSHY OR BUCK CREEK.—Leon County; rises 2½ miles southwest of Robbins; flows southwesterly 15 miles into Navasota River (which discharges into the Brazos) near the International & Great Northern Railroad crossing.

BRUSHY CREEK.—Lamar and Red River counties; rises in southeastern part of Lamar County; flows southeasterly 7 miles into Little Sandy Creek (tributary to Sulphur River and thus through Red River to the Mississippi) at the county line about 2 miles north of the southeastern corner of Lamar County.

BRUSHY CREEK.—Marion County; rises near the county line in southwestern part of county; flows northeasterly 4½ miles into Big Cypress Bayou (tributary to Caddo Lake, which discharges into Mississippi River through Red River).

BRUSHY CREEK.—Milam and Williamson counties; rises 2 miles southwest of Buttercup in southwestern part of Williamson County; flows northeasterly 60 miles into San Gabriel River (tributary through Little River to the Brazos) about 3 miles above mouth of San Gabriel River and 13 miles northeast of Thorndale. Taylor, Bastrop, Georgetown, and Austin topographic maps.

BRUSHY CREEK.—Madison County; small stream flowing into Caney Creek (tributary to Trinity River) northwest of the town of Madisonville in the northwestern part of the county.

BRUSHY CREEK.—Montague County; small stream flowing through southern part of county into Denton Creek (tributary to Elm Fork of the Trinity and thus to Trinity River). Montague topographic map.

BRUSHY CREEK.—Robertson County; small tributary to Big Cedar Creek (tributary to Navasota River and thus to the Brazos) northeast of Wheelock in southeastern part of county; length, 6 miles.

BRUSHY CREEK.—Stephens County; rises 3 miles northwest of Eolian in western part of county; flows northeasterly 6 miles into Sandy Creek (tributary to Gonzales Creek through Hubbard Creek and thus to Clear Fork of Brazos River and the Brazos). Albany and Breckenridge topographic maps.

BRUSHY CREEK.—Uvalde County; small intermittent stream in northern part of county; flows southerly 5 miles into Frio River (tributary to the Nueces) at Florea Ranch. Uvalde topographic map.

BRUSHY CREEK.—Washington and Austin counties; rises in southwestern part of Washington County; flows southerly 5 miles into West Fork of Mill Creek (tributary through Mill Creek to Brazos River) in northwestern part of Austin County.

BRUSHY CREEK.—Young and Jack counties; rises in the northeastern part of Young County; flows northeasterly 7 miles into School Creek (tributary to West Fork of Trinity River and thus to the Trinity) in the northwestern corner of Jack County.

BRUTON CREEK.—Red River County; rises about 2 miles northwest of Bagwell in western part of county; flows southerly 10 miles into Guest Creek (tributary through Cuthand Creek to Sulphur River and thus to the Mississippi through Red River).

BRUTONS CREEK.—Morris County; rises about 2 miles north of Daingerfield in central part of county; flows southerly 12 miles into Big Cypress Bayou (tributary to Caddo Lake and thus through Red River to the Mississippi) near the corner of Morris, Camp, and Upshur counties. Daingerfield topographic map.

BUCK BRANCH.—Erath County; headwater stream flowing southeasterly 4 miles to its junction with Green Creek (tributary to Bosque River and thus to the Brazos) north of the town of Dublin. Stephenville topographic map.

BUCK BRANCH.—Gonzales County; an intermittent stream flowing southerly 8 miles to its junction with Sandy Fork of Peach Creek (tributary to Peach Creek and thus to the Guadalupe) 2½ miles south of Thomsonville. Flatonia topographic map.

BUCK BRANCH.—Montague County; small intermittent stream flowing into Elm Fork of Trinity River (which discharges into the Trinity) south of Saint Jo. Montague topographic map.

BUCK CREEK.—Angelina County; rises about 4 miles northeast of Homer; flows southerly 18 miles into Neches River 7 miles southwest of Manning.

BUCK CREEK.—Cooke County; small intermittent stream flowing into Timber Creek (tributary through Jordan and Isle du Bois Creeks to Elm Fork of Trinity River and thus to the Trinity) about 3 miles northwest of Woodbine. Gainesville and Denison topographic maps.

BUCK CREEK.—Lavaca County; rises 6 miles north of Hallettsville; flows southerly 5 miles into Lavaca River (thus to Gulf of Mexico through Matagorda Bay) near Hallettsville.

BUCK CREEK.—Newton County; flows easterly 9 miles into Sabine River in the northeastern corner of the county.

BUCK CREEK.—Palo Pinto and Erath counties; joins Palo Pinto Creek (tributary to Brazos River) 1½ miles southwest of Brazos in southeastern part of Palo Pinto County; length, 14 miles. Stephenville and Palo Pinto topographic maps.

BUCK CREEK.—Sabine County; small stream flowing into Magnolia Creek (tributary to Richland and Sixmile creeks, thence to Sabine River) in southeastern part of county.

BUCK CREEK.—Somerville County; rises near Johnson-Somerville county line; flows southerly 4½ miles into Brazos River in the southeast corner of the county; intermittent. Granbury topographic map.

BUCK CREEK.—Taylor and Callahan counties; rises 6 miles southeast of Elmdale; flows northwesterly 12 miles into Lytle Creek (tributary to Elm Creek and thus through Clear Fork of Brazos River to the Brazos) near Jones-Taylor county line; partially intermittent. Anson and Abilene topographic maps.

BUCK CREEK.—Titus County; rises in northeastern part; flows northerly 4 miles into Horse Creek (tributary to Whiteoak Bayou, thence through Sulphur and Red rivers to the Mississippi).

BUCKET CREEK.—Karnes County; small stream flowing through the southern part of the county into Escondido Creek and thus to San Antonio River (tributary to the Guadalupe).

BUCKEYE CREEK.—Shelby County; small stream flowing into Patroon Bayou (tributary to Sabine River) south of Patroon in southeastern part of county.

BUCKHAM CREEK.—Lamar County; rises about 3 miles southeast of Petty in southwestern part of county; flows southeasterly 6 miles into North Sulphur River (tributary to Sulphur River and thus through Red River to the Mississippi) at the southern boundary of the county.

BUCKLEYS CREEK.—North Prong; Val Verde County; small stream in northeastern corner of county; flows into Buckleys Creek and thus to Devils River (tributary to Rio Grande).

BUCKLEYS CREEK.—Sutton and Val Verde counties; rises in extreme northeastern corner of Val Verde County near the Sutton-Val Verde County line; flows southwestward 18 miles to its junction with Devils River (tributary to Rio Grande) 7 miles northeast of Juno; intermittent.

BUCKNERS CREEK.—Bastrop and Fayette counties; rises in southeastern part of Bastrop County; flows easterly 2 miles through Bastrop County then 22 miles through Fayette County into Colorado River at La Grange. Flatonia topographic map.

BUENA CREEK.—Terrell County; rises in southwestern part; flows southeasterly into Rio Grande; intermittent. Dryden Crossing topographic map.

BUFORD BRANCH.—King County; rises in northwestern part; flows northeasterly 11 miles into North Wichita River (tributary to Wichita River, and thus through Red River to the Mississippi) near Cottle-King county line.

BUFORD CREEK.—Dickens County; rises in northeastern part of county; a small headwater stream of North Wichita River (tributary to Wichita River and thus through Red River to the Mississippi; in parts of King and Cottle counties North Wichita River is caller Buford Creek.

Buffalo Bayou.—Fort Bend and Harris counties; rises in extreme northern part of Fort Bend County; flows easterly 8 miles through Fort Bend County, then 38 miles through Harris County into San Jancinto Bay (and thus to Trinity and Galveston Bay, thence to Gulf of Mexico) at Lynchburg; tidal from the city of Houston at its junction with White Oak Bayou, a distance of 18 miles; has been widened and deepened for commercial purposes as far as Houston. From a point 5 miles below Houston, known as "Turning Basin," to the mouth, it is known locally as "Ship Channel."

Buffalo Creek.—Blanco County; north of Johnson City in the central part of the county; a small intermittent stream flowing into Pedernales River, and thus to the Colorado; length, 4 miles. Blanco topographic map.

Buffalo Creek.—Brazoria County; rises northeast of the town of Brazoria in southern part of the county; flows southeasterly 7 miles into Brazos River.

Buffalo Creek.—Freestone and Limestone counties; rises southeast of Mexia; flows southerly 20 miles into Navasota River (tributary to Brazos River) near Limestone-Leon county line.

Buffalo Creek.—Freestone and Leon counties, rises in the southwestern part of Freestone County; flows southeasterly 30 miles into Upper Keechi Creek (tributary to Trinity River) in northeastern part of Leon County.

Buffalo Creek.—Hardeman and Wilbarger counties; rises about 6 miles southwest of Quanah in southern part of Hardeman County; flows eastward 34 miles into Pease River (tributary to Red River and thus to the Mississippi) 3½ miles northwest of Vernon in northern part of Wilbarger County.

Buffalo Creek.—Johnson County; formed one mile south of Cleburne by union of East and West Buffalo creeks; flows southerly 5 miles into Nolands River (tributary to the Brazos) 3 miles northwest of Rio Vista in central part of county. Cleburne topographic map.

Buffalo Creek.—Lipscomb County; an intermittent stream flowing northerly 6 miles into Wolf Creek (tributary through North Fork of Canadian River to the Canadian and thus through Arkansas River to the Mississippi) 11 miles west of Lipscomb in western part of county.

Buffalo Creek.—Mills County; rises south of Hydesport; flows through the southwestern part of the county into the Colorado; length, 7 miles. Brownwood and San Saba topographic maps.

Buffalo Creek, North Prong of.—Freestone and Leon counties; rises about 6 miles south of Fairfield in Freestone County; flows southeasterly 13 miles into Buffalo Creek (tributary to Upper Keechi Creek, thence to Trinity River) near the county line in northern part of Leon County.

Buffalo Creek.—Rockwall and Kaufman counties; rises in the southwestern part of Rockwall County; flows southerly 14 miles into East Fork of Trinity River (tributary to the Trinity) in western part of Kaufman County. Barnes Bridge topographic map.

Buffalo Creek.—San Saba County; rises 10 miles south of San Saba in the southeastern part of the county; flows 7 miles into Cherokee Creek and thus to Colorado River. San Saba topographic map.

Buffalo Creek.—Tarrant County; rises in northern part of county; flows into Elizabeth Creek (tributary through Denton Creek to Elm Fork of Trinity River and thus to the Trinity). Fort Worth topographic map.

BUFFALO CREEK.—Wichita County; formed 4 miles northwest of Iowa Park by union of North and South forks of Buffalo Creek; flows southeasterly 8½ miles into Wichita River (tributary to Red River and thus to the Mississippi); partially intermittent. Iowa Park and West Wichita Falls topographic maps.

BUFFALO CREEK, NORTH FORK.—Wichita County; rises about 3 miles east of Electra; flows southeasterly 10 miles into Buffalo Creek (tributary to Wichita River, thence to Red River and thus to the Mississippi); intermittent. Barwise School, Fowlkes, and Iowa Park topographic maps.

BUFFALO CREEK, SOUTH FORK.—Wichita County; rises one-half mile south of Electra; flows southeasterly about 10 miles into Buffalo Creek (tributary to Wichita River and thus to Red and Mississippi rivers; intermittent. Electra, Barwise School, and Iowa Park topographic maps.

BUFFALO DRAW.—Sutton County; a stream 9 miles long flowing through the central part of the county into North Llano River (tributary through the Llano to Colorado River). Fort McKavett topographic map.

BUFFALO HEAD CREEK.—Wichita County; rises about one-half mile southwest of Beaver Day; flows southeasterly 18 miles into Wichita River (tributary through Red River to the Mississippi) 8 miles west of Wichita Falls.

BUFFORD CREEK.—Stephens County; rises 4 miles northeast of Breckenridge; flows northward 8 miles into Clear Fork of Brazos River (tributary to the Brazos) in northern part of county. Breckenridge topographic map.

BUKE CREEK.—Kent County; rises at Buke Knob 2 miles southeast of Clairemont; flows easterly 7 miles into Salt Fork of Brazos River (tributary to the Brazos).

BULL CREEK.—Collingsworth County; rises in northwestern part of county; flows southeasterly 5 miles into Willis Creek (tributary to Salt Fork of Red River, and thus through Prairie Dog Town Fork of the Red to Red River thence to the Mississippi).

BULL CREEK.—Polk County; rises in northwestern part of county; flows northeasterly along county line about 4 miles to a point near Caramona where it enters Piney Creek (tributary to Neches River).

BULL CREEK.—Polk County; a stream flowing into Long Tom Creek (tributary to Long King Creek, then to Trinity River) in the northwestern part of county.

BULL CREEK.—Travis County; rises west of Jollyville in the north central part of the county; flows southward 8 miles into Colorado River 4 miles above Austin Dam. Austin topographic map.

BULLHEAD CREEK.—Llano County; rises 4 miles southeast of Starkes in the southwestern part of the county; flows northward 10 miles into Hickory Creek (tributary to Llano River and thus to the Colorado) 7 miles east of Castell. Llano topographic map.

BULL CREEK.—Coleman County; rises north of Waldrip in the southeastern part of the county; flows 13 miles into Colorado River. Coleman and Brady topographic maps.

BULLHEAD CREEK.—Edwards County; a small intermittent tributary to East Nueces River and thus to Nueces River in the eastern part of the county; length, 10 miles. Nueces topographic map.

BULLHEAD CREEK.—Bee County; small stream flowing into Papalote Creek (tributary to Aransas River, Copano Bay, and Gulf of Mexico) in southern part of county; flows southeasterly 10 miles.

BULL HIDE CREEK.—McLennan County; rises 3 miles southwest of Hewitt; flows southeasterly 18 miles into Brazos River near Falls-McLennan county line in southern part of county. Temple topographic map.

BULL HOLLOW.—Schleicher County; a small intermittent stream in the southeastern part of the county; flows 7 miles into Middle Valley and thus to the San Saba (tributary to Colorado River). Fort McKavett topographic map.

BULL CREEK.—Mills County; southeast of Big Valley in the southern part of county; small tributary to Colorado River; length, 8 miles. San Saba topographic map.

BULL HOLLOW.—Sutton County; a small stream in the southern part of county; empties into North Llano River (tributary through the Llano to Colorado River); length, 11 miles. Rock Springs topographic map.

BULLARD CREEK.—Fannin County; rises about 3 miles east of Dodd City in central part of county; flows northerly 5½ miles into Bois d'arc Creek (tributary to Red River, which discharges into the Mississippi).

BULLARD CREEK.—Hall County; a stream 5 miles long rising near central part of county and flowing northeasterly into Prairie Dog Town Fork of Red River (tributary of Red River and thus to the Mississippi).

BULL RUN CREEK.—Armstrong County; rises in southern part; flows southwesterly 8 miles into Prairie Dog Town Fork of Red River (tributary to Red River and thus to the Mississippi) at the southern boundary of the county.

BURGESS CREEK.—Parker County; a small stream flowing into South Fork of Trinity River (tributary through Clear Fork of Trinity River to West Fork of Trinity River and thus to the Trinity) west of the town of Anneta. Weatherford topographic map.

BURKE CREEK.—Hopkins and Wood counties; rises in southern part of Hopkins County; flows southerly 13 miles into Lake Fork of Sabine River (tributary to the Sabine) in northwestern part of Wood County.

BURLESON CREEK.—Lampasas County; rises in southern part of county; flows southeastward 5 miles into Sulphur Creek (tributary to Lampasas River and thus through Little River to the Brazos) at Lampasas. Lampasas topographic map.

BURNT OAK CREEK.—Concho County; southeast of Vigo in the southwestern part of the county; flows 6 miles through Kickapoo Creek into Concho River (tributary to Red River and thus to the Mississippi).

BURZALINAS CREEK.—Aransas County; rises in northern part of county; flows southwestward 4 miles into St. Charles Bay and thus to Aransas Bay and Gulf of Mexico.

BURROS CANYON.—Presidio County; small stream flowing southwesterly 4 miles into Rio Grande 1 mile southeast of Santiago in southern part of county; intermittent. Polvo topographic map:

BURRO CREEK.—Dimmitt County; small tributary to San Roque Creek (thence to Nueces River) in southeastern part of county; flows northward and westward; length, 14 miles.

BURRETT CREEK.—Wise County; small stream joining West Fork of Trinity River (tributary to the Trinity) near Newark in southeastern part of county.

BUSBY BRANCH.—Fayette County; rises north of Muldoon in the western part of county; an intermittent tributary to Colorado River through Buckner Creek; length, 4 miles. Flatonia topographic map.

BUSHY CREEK.—Ellis County; rises in northern part 6 miles southwest of Ferris; flows southeasterly into Trinity River. Dallas topographic map.

BUSH KNOB CREEK.—Throckmorton County; a stream flowing northeasterly 9 miles into Elm Creek (tributary to the Brazos) northeast of Masters in eastern part of county.

BUTLER CREEK.—Cass County; rises about one-half mile north of Anti school; flows southwesterly 6 miles into Black Bayou (tributary to Caddo Lake, thence through Red River to the Mississippi) about 3 miles northwest of Atlanta in northern part of county.

BUTTERNUT CREEK.—Runnels County; a small stream east of Ballinger in the southeastern part of the county; flows 7 miles to its junction with Mustang Creek (tributary to Colorado River.) Ballinger topographic map.

BUZZARDWING CREEK.—Montague County: small intermittent stream flowing about 3 miles west of Battle-ax School into Belknap Creek (tributary to Red River and thus to the Mississippi) in norhwestern part of county. Montague topographic map.

BYERS LAKE.—Bowie County; about 5½ miles west of Index in northeastern part of county; outlet, Red River (tributary to the Mississippi); formerly a channel of Red River; small.

CABEZA CREEK.—Dewitt, Karnes, and Goliad counties; rises in the southwestern part of Dewitt County; flows southeasterly 9 miles through Dewitt County, 7 miles through Karnes County, then 13 miles through Goliad County to a point 6 miles west of Goliad, where it empties into San Antonio River (tributary to the Guadalupe).

CACTUS BRANCH.—Falls County; rises southwest of Lott; flows southerly 5 miles into Pond Creek (tributary to Brazos River) in southern part of county. Temple topographic map.

CADENA CREEK.—Goliad County; small stream south of the town of Goliad in the central part of county; flows into San Antonio River and thus to the Guadalupe.

CADDO CREEK.—Franklin County; small stream rising in southwestern part of county and flowing into Big Cypress Creek, thence to Caddo Lake and thus through Red River to the Mississippi.

CADDO CREEK.—Henderson and Anderson counties; rises in the southeastern part of Henderson County; flows southeasterly 14 miles into Neches River near Reese.

CADDO CREEK.—Harrison County; rises in southeastern part; flows southwesterly 7 miles into Caney Creek (tributary to the Sabine) at the Harrison-Panola County line.

CADDO CREEK.—Young County; a small intermittent stream in southeast corner of county flowing southerly 3½ miles into Brazos River.

CADDO FORK OF SABINE RIVER.—Hunt County; rises about 4 miles west of the town of Celeste; flows southeasterly 36 miles to its confluence with south Fork of Sabine River (thence to Sabine River) in the southeastern corner of the county.

CADDO LAKE.—Marion and Harrison counties, Tex., and Caddo Parish, La.; one of a series of lakes adjacent to Red River in the vicinity of Shreveport, La.; an expansion of Big Cypress and Little Cypress creeks; heads about 4 miles east of Jefferson in southern part of Marion County, Tex.; enters Red River (tributary to the Mississippi) through Lake Soda at Shreveport, La.; length from head to Louisiana boundary, 24 miles; entire length from source to its junction with Lake Soda 15 miles northwest of Shreveport, approximately 32 miles; average width about 3 miles; total area, 110 square miles; called "Ferry Lake" at upper end.

CALAHAN CREEK.—Caldwell County; small intermittent stream north of Fentress in the southern part of the county; empties into Crooked Branch (tributary to San Marcos River and thus to the Guadalupe). San Marcos topographic map.

Calamity Creek.—Brewster County; heads 5 miles south of Alpine; takes southerly course 30 miles to its confluence with Goat Creek (tributary to Maravilla Creek and thus to Rio Grande). Alpine topographic map.

Calaveras Creek.—Wilson and Bexar counties; rises 1 mile south of Martinez in the eastern part of Bexar County; flows southerly 10 miles through Bexar County, then 5 miles through Wilson County into San Antonio River (tributary to the Guadalupe) near Calaveras. San Antonio topographic map.

Calf Creek.—Donley County; rises in central part of county; flows southwesterly 3 miles into Saddlers Creek (tributary to Salt Fork of Red River, thence to Prairie Dog Town Fork of the Red and thus through Red River to the Mississippi).

Calf Creek.—Grayson County; rises about 2 miles northeast of Sherman; flows southeasterly 5 miles into Choctaw Creek (tributary to Red River and thus to the Mississippi). Denison topographic map.

California Creek.—Val Verde County; rises about 4 miles east of Feely; flows southerly 7 miles into Evans Creek (tributary to Devils River and thus to Rio Grande); intermittent.

California or South Paint Creek.—Throckmorton, Haskell, Jones, and Fisher Counties; rises 10 miles northeast of Roby in northeastern part of Fisher County; flows northeastward 70 miles into Clear Fork of Brazos River (tributary to Brazos River) in southwestern part of Throckmorton County. Roby and Anson topographic maps.

Callett Creek.—Wise County; joins Denton Creek (which discharges into Trinity River through the Elm Fork of the Trinity) south of Slidell in eastern part of county.

Camp Branch.—Bowie County; rises about 2 miles northwest of Bassett; empties into Bassett Creek (tributary to Sulphur River and thus through Red River to the Mississippi) in southwestern part of county.

Camp Creek.—Anderson County; rises 1 mile east of Douglas; flows southwesterly 4 miles into Trinity River at Magnolia.

Camp Creek.—Austin and Washington Counties; rises in southwestern part of Washington County; flows southerly 7 miles into West Fork of Mill Creek (tributary to Mill Creek and thus to Brazos River) near Industry in northwestern part of Austin County.

Camp Creek.—Bell County; rises near Oenaville in eastern part of county; flows southeasterly 16 miles into Big Elm Creek (tributary through Little River to the Brazos). Temple and Taylor topographic maps.

Camp Creek.—Cass County; a small intermittent stream flowing into Sulphur River (tributary to Red River, which discharges into the Mississippi) about one-half mile southeast of Spencer Spur in northeastern part of county. Atlanta topographic map.

Camp Creek.—Coleman County; southwest of Trickham in the southeastern part of the county; flows 14 miles to its junction with Home Creek (tributary to the Colorado). Coleman and Brady topographic maps.

Camp Creek.—Cooke County; rises about 5 miles south of Bulcher in northwestern part of county; flows northerly 7 miles into Red River (tributary to the Mississippi) a mile north of Bulcher. Gainesville topographic map.

Camp Creek.—Donley County; a stream 4 miles long flowing southerly through eastern part of county into McCormick Creek (tributary to Salt Fork of Red River, and thus through Prairie Dog Town Fork of Red River to the Red and Mississippi rivers).

CAMP CREEK.—Johnson County; rises 3½ miles south of Bono in southwestern part of county; flows southwesterly 8 miles into Brazos River. Granbury topographic map.

CAMP CREEK.—Kent County; rises 2 miles northeast of Clairemont in central part of county; flows easterly 5 miles into Salt Fork of Brazos River (which discharges into the Brazos).

CAMP CREEK.—Kent and Dickens Counties; a stream 8 miles long flowing eastward along the Kent-Dickens county line into Duck Creek, and thus through Salt Fork of Brazos River to the Brazos.

CAMP CREEK.—Lee County; small intermittent stream flowing southerly 4 miles into Watleye Creek (tributary through Cross Creek to Second Yegua Creek and thus through Yegua Creek to Brazos River) in northwestern part of county. Bastrop topographic map.

CAMP CREEK.—Lipscomb County; an intermittent stream rising 5 miles northwest of Higgins and flowing northerly 10 miles into Wolf Creek (tributary through North Fork of Canadian River to the Canadian and thus through Arkansas River to the Mississippi) 10 miles east of Lipscomb in eastern part of county.

CAMP CREEK.—Lynn County; a stream 3 miles in length rising in southeastern part of county and flowing southerly into Double Mountain Fork of Brazos River (which discharges into Brazos River) near Lynn-Garza county line.

CAMP CREEK.—Mason and McCulloch Counties; a stream flowing through the southern part of McCulloch County and northern part of Mason County into San Saba River and thus to the Colorado; length, 11 miles. Brady and Mason topographic maps.

CAMP CREEK.—Robertson County; rises near southeastern boundary of county; flows easterly 6 miles into Navasota River (tributary to Brazos River) east of Franklin.

CAMP CREEK.—San Saba County; north of San Saba in the eastern part of county; 9 miles in length flowing into San Saba River and thus to the Colorado. San Saba topographic map.

CAMP CREEK.—Young County; a westward flowing stream 8 miles long joining Brazos River close to Young-Throckmorton county line near Spring Creek.

CAMP LAKE SLOUGH.—Uvalde and Zavalla Counties; intermittent; rises 4 miles south of Uvalde; flows southeasterly 6½ miles through Uvalde County, then 9 miles through Zavalla County into Leon River (tributary to Frio and Nueces Rivers). Uvalde topographic map.

CAMPBELL CREEK.—Armstrong and Briscoe Counties; rises in southern part of Armstrong County; flows southeasterly 5½ miles into Prairie Dog Town Fork of Red River (tributary to Red River and thus to the Mississippi) in northern part of Briscoe County.

CAMPBELL CREEK.—Caldwell County; near McMalan; empties into Tenney Creek and thus through Plum Creek and San Marcos River to the Guadalupe. San Marcos and Flatonia topographic maps.

CAMPBELL CREEK.—Guadalupe County; small intermittent stream flowing into Cottonwood Creek (thence to Guadalupe River) south of Seguin. San Marcos topographic map.

CAMPBELL CREEK.—Franklin County; rises in northeastern part of county; flows northerly 4 miles into Whiteoak Bayou (tributary to Sulphur River and thus through Red River to the Mississippi).

CAMPBELLS CREEK.—Lavaca County; a stream 2 miles long flowing southwesterly into Buck Creek (tributary to Lavaca River, Matagorda Bay, and Gulf of Mexico) 2 miles northwest of Hallettsville.

CAMPBELLS CREEK.—Robertson County; rises in southwest corner of county; flows southwestward 7 miles into Little Brazos River (tributary to Brazos River) 3 miles west of Benchley.

CAMPBELL BRANCH.—Montague County; small intermittent stream flowing into Red River (tributary to the Mississippi) in northeastern part of county. Montague topographic map.

CAMPBELL DRAW.—Menard County; an intermittent tributary joining San Saba River, tributary to the Colorado) in the western part of the county; 3½ miles east of Fort McKavett; length, 9 miles. Fort McKavett topographic map.

CAMPGROUND CREEK.—Llano County; an intermittent stream 2 miles southwest of the town of Bluffton; flows through eastern part of the county into Colorado River; length, 5 miles. Burnet topographic map.

CAMP WOOD CREEK.—Edwards County; a small intermittent tributary to East Nueces River (thence to Nueces River) in the southeastern part of the county at Camp Wood; length, 4 miles. Nueces topographic map.

CANADA DE PADILLA CREEK.—Atascosa County; rises on the boundary of Atascosa and Frio counties; flows southeastward 8 miles into Atascosa River (tributary to Nueces River through the Frio).

CANDLER BRANCH.—Brown County; rises 2 miles east of Ricker in southeastern part of county; flows westerly 3 miles into Steppe Creek (tributary to Pecan Bayou and thus to Colorado River); intermittent. Brownwood topographic map.

CANDILLA CREEK.—Brewster and Terrell counties; rises in eastern part of Brewster County near Brewster-Terrell county line; flows southeasterly 3½ miles, crossing Brewster-Terrell county line into Washboard Canyon (tributary to San Francisco Creek and thus to Rio Grande); intermittent. Indian Wells topographic map.

CANE CREEK.—Hunt County; tributary to Cowleach Fork of Sabine River (thence to Sabine River through Caddo Fork of the Sabine) in eastern part of the county.

CANE CREEK.—Lamar County; rises about 3 miles west of Brookston in southwestern part of county; flows southeasterly 11 miles into North Sulphur River, (tributary to Sulphur River, thence through Red River to the Mississippi) in the southwestern part of the county at the southern boundary.

CANE CREEK.—Kaufman and Henderson counties; rises in southwestern part of Kaufman County; flows southerly 9 miles into Trinity River, about 2 miles northwest of Buffalo in Henderson County.

CANEY BAYOU.—Houston County; rises about 4 miles southwest of Crockett; flows southwesterly into Trinity River south of Vistula; length, 18 miles.

CANEY BAYOU.—Shelby County; small stream; flows into Attoyac Bayou (tributary through Angelina River to the Neches) in northwestern part of county.

CANEY BAYOU.—Wharton and Matagorda counties; rises near Wharton in Wharton County; flows southeasterly 65 miles into the east end of Matagorda Bay, thence through another channel into Gulf of Mexico.

CANEY BRANCH.—Matagorda County; rises in the east central part of the county; flows southeasterly 6 miles into Caney Bayou, and thus to Matagorda Bay and Gulf of Mexico.

CANEY CREEK.—Bowie County; rises about 1½ miles south of Whaleys; flows southeasterly 9 miles into Langum Creek (tributary to Sulphur River and thus to the Mississippi through Red River) 1 mile south of Clem in southern part of county. New Boston topographic map.

CANEY OR WHATLEY CREEK.—Cass County; rises about 2 miles west of Munz, in northern part of county; flows northeasterly 9½ miles into Sulphur River (tributary through Red River to the Mississippi), about 5 miles northeast of Bryans Mill. Linden and New Boston topographic maps.

CANEY CREEK.—Cass County; rises 4 miles northwest of Putman; flows westerly 3 miles into Kelley Creek (tributary to Black Cypress Bayou, thence through Big Cypress Bayou to Caddo Lake, and thus through Red River to the Mississippi). Daingerfield topographic map.

CANEY CREEK.—Fannin County; rises about 4 miles south of Savoy, in western part of county; flows northeasterly 18 miles into Red River (tributary to Mississippi River) northwest of Ravenna.

CANEY CREEK.—Grimes and Montgomery counties; rises in the eastern part of Grimes County; flows northeasterly 3 miles through Grimes County, then 9 miles through Montgomery County into Lake Creek (tributary to West San Jacinto River, San Jacinto River, and Gulf of Mexico).

CANEY CREEK.—Harrison and Panola Counties; rises in southeastern part of Harrison County; flows southwesterly about 12 miles into Sabine River, in the northwestern part of Panola County.

CANEY CREEK.—Henderson County; rises about 5 miles northeast of Athens; flows westerly and southwesterly 19 miles into Cedar Creek (tributary to Trinity River).

CANEY CREEK.—Hopkins County; a small stream in the eastern part of county flowing northerly 8 miles into Whiteoak Bayou (tributary to Sulphur River and thus to the Mississippi through Red River).

CANEY CREEK.—Hopkins and Wood Counties; rises about 9½ miles southeast of Sulphur Springs in the southern part of Hopkins County; flows southwesterly 18 miles into Lake Fork of Sabine River (tributary to the Sabine) about 5 miles west of Quitman, in Wood County.

CANEY CREEK.—Leon County; rises near Concord; flows southwestward 12 miles into Navasota River (tributary to the Brazos).

CANEY CREEK.—Madison County; rises in the northwestern part of the county; flows southeasterly 22 miles into Bidais Creek (tributary to Trinity River) 8 miles southeast of Madisonville.

CANEY CREEK.—Madison County; rises near Madison-Leon county line; flows southwesterly 8 miles into Navasota River (tributary to the Brazos) west of George.

CANEY CREEK.—Montgomery County; rises in the northwest corner of the county; flows southeasterly 17 miles into West San Jacinto River, thence to San Jacinto River, Galveston Bay, and Gulf of Mexico.

CANEY CREEK.—Nacogdoches County; rises in eastern part; flows easterly 8 miles into Attoyac Bayou and thus through Angelina River to the Neches.

CANEY CREEK.—Newton County; rises about 7 miles north of Newton; flows southeasterly 19 miles into Sabine River.

CANEY CREEK.—Panola County; a small tributary to Murvalls Bayou (thence to Sabine River) in southwestern part of county.

CANEY CREEK.—Polk and Tyler counties; rises about 3 miles southwest of Barnum, in Polk County; flows northeasterly into Neches River in the extreme northwestern corner of Tyler County.

CANEY CREEK.—Rains County; tributary to Sabine River in northwestern part of county.

CANEY CREEK.—Red River County; rises about 4 miles southwest of Avery; flows southerly 12 miles into Sulphur River (tributary to Red River, which discharges into the Mississippi) in southeastern part of county.

CANEY CREEK, EAST FORK OF.—Red River County; small stream rising south of Avery, in southeastern part of county, and flowing to Caney Creek, thence to Sulphur River and thus through Red River to the Mississippi.

CANEY CREEK.—Red River County; a small stream 7 miles north of Annona, flowing into Pecan Bayou (tributary to Red River and thus to the Mississippi) in the northeastern part of county.

CANEY CREEK.—San Augustine County; small stream discharging into Ayish Bayou (tributary to Angelina River and thus to the Neches) south of San Augustine in northern part of county.

CANEY CREEK.—San Augustine County, eastern part; small stream flowing into Chiamon Bayou (tributary to Ayish Bayou, thence to Angelina and Neches rivers) in eastern part of the county.

CANEY CREEK.—Trinity County; rises about 3 miles west of Groveton; flows southwesterly 11 miles into White Rock Creek (tributary to Trinity River) about a mile above its mouth.

CANEY CREEK.—Upshur County; rises 3 miles southwest of Lafayette in northern part of county; flows southerly 7 miles into Little Cypress Creek (tributary to Caddo Lake and thus through Red River to the Mississippi) about 3 miles northeast of Gilmer.

CANEY CREEK.—Wood and Upshur counties; rises in northeastern part of Wood County; flows southeasterly 13 miles into Little Cypress Creek (tributary to Caddo Lake and thus through Red River to the Mississippi) in northwestern part of Upshur County.

CANEY CREEK.—Walker and Montgomery counties; rises in southeastern part of Walker County; flows southeasterly 3 miles through Walker County, then 33 miles through Montgomery County into Peach Creek (tributary to East San Jacinto River, Galveston Bay, and Gulf of Mexico) near southeastern county line.

CANEY CREEK.—Washington and Austin counties; rises in southern part of Washington County; flows easterly 13 miles along Washington-Austin county line into Brazos River, southwest of Hempstead.

CANNAI CREEK.—Foard County; small stream in northern part of county flowing into Pease River (which discharges into the Mississippi through Red River).

CANNON GULLY.—Harris County; rises in northwestern part of county 2½ miles northwest of Willow Siding; flows southeasterly 2 miles into Willow Creek; intermittent. Louetta topographic map.

CANOE BAYOU.—Matagorda County; rises in the southeastern part of the county; flows southeasterly 10 miles into Live Oak Creek, and thence to Matagorda Bay and Gulf of Mexico.

CANON CREEK.—Bandera and Real counties; a small intermittent stream rising in southeastern part of Real County and flowing southeasterly 12 miles to its junction with Sabinal River (thence to the Nueces through Frio River) near Utopia.

CANTAU CREEK.—Guadalupe County; small stream flowing into Guadalupe River about 5 miles southeast of Seguin. San Marcos topographic map.

CANYON CREEK.—Bandera and Real counties; rises near Bandera-Real county line; flows southeasterly 12 miles into Sabinal River (tributary to Frio River and thus to the Nueces) near Bandera-Uvalde county line.

CANYON CREEK.—Clay and Montague counties; rises 4 miles northeast of Bellevue in eastern part of Clay County: flows easterly 4 miles into Belknap Creek (tributary to Red River and thus to the Mississippi) in northwestern part of Montague County. Montague topographic map.

CANYON CREEK.—Lipscomb County; a stream flowing northerly 7 miles into Wolf Creek (tributary through North Fork of Canadian River to the Canadian and thus through Arkansas River to the Mississippi) 7 miles east of Lipscomb in eastern part of county; intermittent.

CANADIAN RIVER.—Hemphill, Roberts, Hutchinson, Moore, Potter, and Oldham counties; one of the large tributaries of Arkansas River; rises in Raton Pass, Colfax County, northeastern New Mexico; flows southeasterly to a point near the center of western line of Oldham County, where it enters the State of Texas; continuing this southeasterly course it crosses the Panhandle of Texas, passes into Oklahoma from Hemphill County, Texas, and joins Arkansas River (tributary to the Mississippi) 20 miles east of Canadian in eastern part of Oklahoma; total length, 760 miles, of which 190 miles are in Texas.

The stream flows through a wide and sandy channel which is subject to large seepage losses. During dry seasons it is without flow, but at times it is subject to destructive floods.

Irrigation is not practiced to any great extent by diversions from the river and there are no water-power developments in Texas. Area of drainage basin in Texas, 9,740 square miles, principal tributaries in Texas, Wolf Creek, Big Blue Creek, and Red Deer Creek.

CAPADERO CREEK.—Victoria County; southwest of Victoria in the western part of the county; flows into Coleto Creek (tributary to the Guadalupe).

CAPOTE CREEK.—Presidio County; rises on western side of Capote Peak, 12 miles northeast of Upper San Antonio, Mexico; flows southwesterly 15 miles into Rio Grande opposite Upper San Antonio, Mexico. San Carlos topographic map.

CAPOTE DRAW.—Presidio County; rises in Cleveland Brakes southwest of Marfa in northern part of county; flows northerly 32 miles into Chispa Creek (thence to Wildhorse Creek which sinks in sand) 11 miles northwest of Ryan; intermittent. San Carlos and Marfa topographic maps.

CARANCAHUA CREEK.—Jackson, Matagorda, and Calhoun counties; rises in the northwestern corner of Matagorda County; takes a very irregular course 11 miles through Matagorda County, 15 miles through Jackson County, then for 2 miles along the boundary between Jackson and Calhoun counties; thence through Carancahua Bay into Matagorda Bay and Gulf of Mexico.

CARACOL CREEK.—Bexar County; an intermittent stream in the northwestern part of the county; tributary through Medio Creek to Medina River, and thus through San Antonio River to the Guadalupe. San Antonio topographic map.

CARBAJAL CREEK.—Wilson and Karnes counties; small stream flowing through the eastern part of Wilson and western part of Karnes County into Rio Cibolo and thus to the San Antonio (tributary to Guadalupe River).

CARLOW CREEK.—Cass County; rises about 2 miles south of Douglasville in northern part of county; flows northwesterly 6 miles into Powell Creek (tributary through Sulphur River to the Red and thus to Mississippi River) about 2½ miles northwest of Douglasville. Linden topographic map.

CARNELIAN CREEK.—Montgomery County; rises in the north central part of the county; flows southerly 12 miles into West San Jacinto River (tributary to San Jacinto River and Galveston Bay, thence to Gulf of Mexico).

CAROLINA CREEK.—Walker County; joins Trinity River at Carolina in the northeastern part of the county.

CARPENTERS BAYOU.—Harris County; rises 5 miles northwest of Sheldon in the eastern part of the county; flows southeasterly 15 miles into Ship Channel (Buffalo Bayou) (thus to Galveston Bay and Gulf of Mexico) about 2 miles southwest of Lynchburg; tidal stream for 2 miles in lower course. Harmaston, Fauna and Burnet Bay topographic maps.

CARPERS CREEK.—Comal County; rises in northern part of county; flows into Blanco River and thus through the San Marcos to Guadalupe River.

CARRIZO CREEK.—Dallam and Hartley counties; an intermittent stream rising in eastern part of Colfax County, N. Mex., entering Texas at a point approximately 15 miles south of Texline in southern part of Dallam County, and flowing southeasterly 35 miles into Mustang Creek (tributary to Canadian River and thus through Arkansas River to the Mississippi) 4 miles northwest of Hartley.

CARROL CREEK.—Donley County; rises about 1 mile south of Jericho in northwestern part of county; flows southerly 11 miles into Salt Fork of Red River (tributary to Prairie Dog Town Fork of the Red and thus through Red River to the Mississippi) at Old Clarendon.

CARROLLS CREEK.—Jack County; rises about 6 miles south of Jacksboro in the south central part of the county; flows northeasterly 12 miles into West Fork of Trinity River (tributary to the Trinity) in the eastern part of the county, 8 miles northeast of Jacksboro.

CARREASE CREEK.—Live Oak County; rises in the southwestern part of the county, where it is known as Olmos Creek; flows easterly 20 miles into Nueces River near Cornelia post office.

CARRIZO CREEK.—Dimmit County; small stream; rises in northwestern part of county; flows northeastward to its junction with Nueces River; length, 24 miles.

CARTER LAKE.—Bowie County; about 4½ miles west of Index in northeastern part of county; an old channel of Red River (tributary to the Mississippi); very small.

CASAS BLANCAS CREEK.—Starr County; formed in western part of county by the union of Palitas Blancas Creek and Arroyo del Quenada; flows southerly 3½ miles into Rio Grande 3 miles southeast of Salineno.

CASA BLANCA CREEK.—Victoria County; rises in the eastern part of the county; flows eastward into Gariolas Creek, thence to Gulf of Mexico through Arenosa Creek, Lavaca and Matagorda bays.

CASCONADE CREEK.—Sterling and Coke counties; rises north of Bliss in the northeastern corner of Sterling County; flows easterly 9 miles into Colorado River in the northwestern corner of Coke County.

CASE CREEK.—Grayson County; joins Range Creek (tributary to Isle du Bois Creek, and thus to Trinity River through Elm Fork of the Trinity) about 1¼ miles east of the town of Ethel; small intermittent stream. Denison topographic map.

CASTILLITO CREEK.—Webb County; small tributary to Prieto Creek, thence to the Nueces in northeastern part of county.

CASTLEMAN CREEK.—McLennan County; rises near Hewitt in southern part of county; flows easterly 15 miles into Brazos River near Falls-McLennan County line. Temple topographic map.

CAT CREEK.—Lipscomb County; an intermittent stream 4 miles long joining Wolf Creek (tributary to North Fork of Canadian River and thus through Canadian and Arkansas rivers to the Mississippi 2½ miles east of Lipscomb in central part of county.

CAT CREEK.—Newton County; small tributary to Clear Creek (thence to Yellow Bayou, Little Cow Creek, and Sabine River) about 3 miles west of Burkeville.

CATFISH BAYOU.—Henderson and Anderson counties; rises about 8 miles southwest of Athens in Henderson County; flows southwesterly 30 miles into Trinity River in western part of Anderson County northwest of Palestine.

CATFISH CREEK.—Cottle and Foard counties; rises about 5½ miles east of Swearingen in northeastern part of Cottle County; flows northerly 6 miles along the county line into Pease River (tributary to Red River and thus to the Mississippi) near northwestern corner of Foard County.

CATFISH CREEK.—Hale, Lamb, Castro, and Parmer Counties; rises in Curry and Quay counties in eastern part of New Mexico, crosses Texas-New Mexico State line 6 miles north of Farwell; flows southeasterly 70 miles into White River (tributary through Salt Fork of Brazos River to the Brazos) in northern part of Hale County.

CAVE CREEK.—Coryell County; an intermittent stream flowing northeasterly 6 miles into Middle Bosque River (tributary through South Bosque and Bosque rivers to the Brazos) in northern part of county. Meridian topographic map.

CAVE CREEK.—Edwards County; a small intermittent tributary to West Nueces (tributary to Nueces River) in the southern part of county; rises at Goode; flows southwesterly 13 miles. Nueces topographic map.

CAVE CREEK.—Gillespie County; small stream in the western part of county flowing southeasterly 5 miles to its junction with Pedernales River (tributary to Colorado River) 1 mile west of Stonewall. Fredericksburg topographic map.

CAVASSO CREEK.—Refugio and Aransas counties; rises in the eastern part of Refugio County; flows 3 miles through Refugio County, then 4 miles through Aransas County into St. Charles Bay and thus to Aransas Bay and Gulf of Mexico.

CAYOTE OR SALT CREEK.—Culberson and Reeves counties; rises north of Plateau in southern part of Culberson County; flows easterly through Toyah Lake into Toyah Creek (and thus through Pecos River to Rio Grande) 7 miles south of Pecos in eastern part of Reeves County.

CEDAR ARROYA.—Terrell County; rises at Cedar Springs, 4 miles southwest of Lazier and south of Watkins in the southeastern part of county; flows southeasterly 8 miles to its junction with Rio Grande 10 miles south of Lazier.

CEDAR CREEK.—Liberty, Harris, and Chambers counties; rises in the western part of Liberty County; flows southerly for 15 miles along boundary line of Harris and Liberty counties, then 16 miles along boundary of Harris and Chambers counties into Trinity Bay, thence to Galveston Bay and Gulf of Mexico. Huffman, Crosby, Walley, Cedar Bayou, and Morgan Point topographic maps.

CEDAR BRANCH.—Dallas County; small stream flowing into Trinity River northwest of city of Dallas. Dallas topographic map.

CEDAR SPRING BRANCH.—Fayette County; west of Flatonia in southwestern part of county; flows into Big Fivemile Creek (tributary to Peach Creek and thus to Guadalupe River); intermittent. Flatonia topographic map.

CEDAR CREEK.—Angelina County; rises near Lufkin in the northwestern part of county; flows southerly 16 miles into Neches River.

CEDAR CREEK.—Bell County; rises near the southwestern corner of McLennan County; flows southwesterly 10 miles into Leon River (tributary through Little River to the Brazos) 3 miles south of Moffat. Temple topographic

CEDAR CREEK.—Caldwell and Bastrop counties; rises north of Mendoza in the northern part of Caldwell County; flows easterly 4 miles through Caldwell County, then 19 miles through Bastrop County to its junction with Walnut Creek (tributary to Colorado River) 3 miles west of Hills Prairie. Austin and Bastrop topographic maps.

CEDAR CREEK.—Dallas County; small stream flowing northeasterly from Hale into Trinity River south of the City of Dallas. Dallas topographic map.

CEDAR CREEK.—Edwards County; a spring-fed tributary to Pulliam Creek (thence to Nueces River) in the eastern part of the county; flows southeasterly 9 miles. Nueces topographic map.

CEDAR CREEK.—Edwards County; a small intermittent tributary in the southern part of the county; unites with West Nueces River (tributary to the Nueces) one-half mile above Black Water Hole; flows easterly 5 miles. Nueces topographic map.

CEDAR CREEK.—Fayette County; a small intermittent tributary through Buckner Creek to Colorado River in the central part of the county; length 2 miles. Flatonia topographic map.

CEDAR CREEK.—Fayette County; small intermittent stream 6 miles in length flowing into Colorado River 2 miles west of West Point in the northwestern part of the county. Flatonia topographic map.

CEDAR CREEK.—Fayette County; small tributary to Colorado River east of LaGrange in eastern part of county; length, 6 miles.

CEDAR CREEK.—Foard County; small stream rising in northern part of county and flowing into Cannal Creek (tributary to Pease River and thus through Red River to the Mississippi).

CEDAR CREEK.—Fort Bend and Brazoria counties; rises in southern part of Fort Bend County; flows southeasterly 8 miles to its junction with San Bernard River, thence to Gulf of Mexico in the western part of Brazoria County.

CEDAR CREEK.—Freestone County; a stream 11 miles long flowing northerly into Tehuacana Creek (tributary to the Trinity) in northeastern part of county.

CEDAR CREEK.—Grayson County; rises about 5 miles east of Howe in southeastern part of county; flows northwesterly 6 miles into Choctaw Creek (tributary to Red River and thus to the Mississippi) about 4 miles southeast of Sherman. Denison topographic map.

CEDAR CREEK.—Grimes County; flows southeasterly 8 miles into Caney Creek (thence to West San Jacinto River, San Jacinto River and Gulf of Mexico) in the southeastern part of the county.

CEDAR CREEK.—Grimes County; rises at Foster Farm in southwestern part of county northeast of the town of Navasota; flows southwesterly 4½ miles through Navasota into Navasota River (tributary to Brazos River). Navasota topographic map.

CEDAR CREEK.—Hemphill and Lipscomb counties; rises 11 miles north of Canadian near the line of Lipscomb and Hemphill Counties; flows in southerly direction joining Canadian River (tributary to Arkansas River and thus to the Mississippi) 3 miles east of Canadian in northern part of Hemphill County; length, 11 miles.

CEDAR CREEK.—Hill County; small stream in northwestern part of county; flows southerly into Brazos River 2 miles southeast of Fort Graham. Cleburne and Waco topographic maps.

CEDAR CREEK.—Hopkins County; small stream flowing into Garrett Creek (tributary through Lake Fork of Sabine River to the Sabine) in southwestern part of county.

CEDAR CREEK.—Hopkins and Franklin counties; rises in southeastern part of Hopkins County; flows southeastward 5 miles into Big Cypress Creek (tributary to Caddo Lake and thus to Red River and the Mississippi) in southwestern part of Franklin County.

CEDAR CREEK.—Hunt County; small stream flowing through south central part of county into Cowleach Fork of Sabine River and thus to the Sabine through Caddo Fork of Sabine River

CEDAR CREEK.—Hunt and Collin counties; rises near northwestern corner of Hunt County; flows southwesterly 14 miles into Pilot Grove Creek (tributary to Sister Grove Creek and thus through East Fork of the Trinity to Trinity River) about 4 miles west of Farmersville in Collin County.

CEDAR CREEK.—Johnson County; a stream flowing westward 3 miles into Brazos River at eastern extremity of DeCordova Bend in western part of county. Granbury topographic map.

CEDAR CREEK.—Knox County; small intermittent stream flowing easterly 2½ miles into Brazos River southeast of Benjamin.

CEDAR CREEK.—McCulloch County; rises in the northern part of county; flows 12 miles into Colorado River. Brady topographic map.

CEDAR CREEK.—Montague and Cooke counties; rises about 3 miles northeast of McCollum in Montague County; flows northeasterly 4 miles into Red River (tributary to the Mississippi) about a mile northwest of Rock Bluff Ferry in extreme northwestern part of Cooke County. Montague and Gainesville topographic maps.

CEDAR CREEK.—Milam and Burleson counties; rises in eastern part of Milam County; flows southeasterly into Spring Creek (tributary to Brazos River) 5 miles north of Caldwell.

CEDAR CREEK.—Navarro County; joins Pecan Creek (tributary through Richland Creek to Trinity River) east of Navarro in southeastern part of county.

CEDAR CREEK.—Rockwall, Kaufman, and Henderson counties; rises near Chisholm in southern part of Rockwall County; flows southeasterly 57 miles into Trinity River in southwestern part of Henderson County; in upper part of its course it is called Brushy Bayou.

CEDAR CREEK.—San Saba County; a small intermittent stream 4 miles long in the southwestern part of county; flows through Deer and San Fernando creeks into Llano River, and thus to the Colorado. Mason topographic map.

CEDAR CREEK.—Taylor County; rises west of Lewis Canyon; flows southeasterly 5 miles into Elm Creek (tributary through Clear Fork of Brazos River to the Brazos) west of Buffalo Gap in western part of county. Abilene topographic map.

CEDAR CREEK.—Taylor County; rises near Tuscola; flows northerly 17 miles into Lytle Creek (tributary to Elm Creek which discharges into Brazos River through Clear Fork of the Brazos) at the town of Abilene. Abilene topographic map.

CEDAR CREEK.—Tom Green, Coke, and Runnels counties; rises near the intersection of Tom Green, Coke, and Runnels counties, in northeastern part of Tom Green County; flows northeasterly 3½ miles into Mule Creek (tributary to Colorado River); intermittent. Hayrick topographic map.

CEDAR CREEK.—Terrell County; rises in southwestern part near Brewster-Terrell county line; flows southeasterly 7 miles into Candilla Creek near Candilla Canyon (tributary to Washboard Canyon, San Francisco Creek, and Rio Grande); intermittent. Indian Wells topographic map.

CEDAR CREEK.—Trinity County; stream flowing northeasterly 12 miles into Neches River in northeastern part of county.

CEDAR CREEK.—Uvalde County; a small intermittent tributary to East Nueces River (thence to Nueces River) in northwestern part of county; length, 6 miles. Nueces topographic map.

CEDAR CREEK.—Waller County; rises in the northwestern corner of the county; flows westerly into Beasom Creek and thus to Brazos River. Howth topographic map.

CEDAR CREEK.—Waller County; rises in extreme northwest corner of Waller County; flows westerly 7 miles into Beasons Creek (tributary to Brazos River) near western corner of Grimes and Waller counties.

CEDAR CREEK.—Washington County; rises 1½ miles northwest of Chappel Hill; flows eastward 3 miles into New Years Creek (tributary to Brazos River) 3 miles northeast of Chappel Hill in southeastern part of county.

CEDAR CREEK.—Washington and Lee counties; rises 2 miles northeast of Ledbetter; flows northeasterly 13 miles along Washington-Lee county line into Yegua Creek (tributary to Brazos River) about 4 miles northeast of Calvin.

CEDAR HOLLOW.—Bastrop County; intermittent water course 3 miles in length; rises 1 mile north of Red Rock in the western part of the county; flows northwesterly into Walnut Creek (tributary to Colorado River) 1 mile southeast of Otis. Flatonia and Bastrop topographic maps.

CEDAR LAKE.—Anderson and Freestone counties; a lake or series of sloughs and old river channels—along county boundary between Anderson and Freestone counties west of Palestine. (Trinity River drainage).

CEDAR LAKE CREEK.—Brazoria and Matagorda counties; rises in northwestern part of Brazoria County; flows southeasterly 10 miles through Brazoria County, then 18 miles along the boundary of Brazoria and Matagorda counties and empties into Cedar Lake which drains into the Gulf of Mexico.

CEDRON CREEK.—Bosque County; rises 2 miles southeast of Pilot Knob east of the town of Meridian in central part of county; flows easterly 12 miles into Brazos River south of the Missouri, Kansas & Texas Railway crossing. Meridian and Waco topographic maps.

CELERY CREEK.—Menard County; rises in central part of county; empties into the San Saba and thus to Colorado River; length, 12 miles. Eden topographic map.

CENTER CREEK.—Wise County; small stream flowing to West Fork of Trinity River (tributary to the Trinity) in the central part of the county.

CHACON CREEK.—Webb County; rises northeast of the town of Laredo; flows southerly 5 miles into Rio Grande about a mile south of Laredo; intermittent.

CHALK CREEK.—Angelina and Jasper counties; rises in southeastern part of Angelina County; flows southerly 6 miles; empties into Neches River north of Aldridge in northwestern part of Jasper County.

CHALK CREEK.—Kinney County; a small intermittent tributary to West Nueces River (thence to Nueces River) in the northeastern part of the county; flows southerly 4 miles. Brackett topographic map.

CHALK HOLLOW.—Donley County; small stream rising in eastern part of county and flowing into Salt Fork of Red River, which discharges into the Red through the Prairie Dog Town Fork of the Red and thus to the Mississippi.

CHAMPLINS CREEK, SOUTH FORK.—Mitchell County; rises in eastern part of the county; flows southwestward 11 miles into North Fork of Champlins Creek (tributary to Colorado River) 5 miles southeast of Colorado.

CHAMPLINS CREEK, NORTH FORK.—Mitchell County; rises near Wastella in the northeastern part of the county; flows southwesterly 19 miles into Colorado River about 7 miles south of the town of Colorado near the center of the county.

CHANNEL CREEK.—Williamson County; rises in southern part of county; flows southeasterly 7 miles into Brushy Creek (tributary through San Gabriel River to Little River and thus to the Brazos) 4 miles northeast of Round Rock. Georgetown topographic map.

CHANDLER BRANCH.—Fayette County; north of Muldoon in the west central part of the county; an intermittent tributary through Buckner Creek to Colorado River; length, 5 miles. Flatonia topographic map.

CHAPARROSA CREEK.—Kinney, Maverick and Zavalla counties; rises in the Anacacho Mountains in the southeastern part of Kinney County; flows 6 miles southeasterly through Kinney County, then 28 miles through Zavalla County into Turkey Creek (tributary to the Nueces through Elm Creek); length, 34 miles. Brackett topographic map.

CHEROKEE BAYOU.—Rusk and Gregg counties; rises about 4 miles northwest of Henderson in Rusk County; flows northeasterly 13 miles to the county line, thence easterly 12 miles, forming the boundary between Gregg and Rusk Counties for 5 miles; empties into the Sabine in Rusk County about 5 miles northeast of Tatum.

CHEROKEE CREEK.—Briscoe County; small stream flowing northward about 61 miles into Prairie Dog Town Fork of Red River (tributary to Red River and thus to the Mississippi) in eastern part of the county.

CHEROKEE CREEK, NORTH FORK.—San Saba County; a small stream 4 miles long in the southeastern part of the county; flows southeasterly through Kuykendall's ranch into Cherokee Creek (tributary to Colorado River). Llano topographic map.

CHEROKEE CREEK.—San Saba County; rises in the southern part of the county 10 miles southwest of Cherokee; flows northeastward 34 miles into Colorado River in the southeastern part of the county 1 mile east of Bend. Llano, San Saba, and Lampasas topographic maps.

CHERRY BRANCH.—Burnet County; a small intermittent stream 2 miles long in the northwestern part of the county; flows into Deer Creek and thus to Colorado River. Burnet topographic map.

CHERRY CANYON.—Jeff Davis and Reeves counties; an intermittent stream which sinks soon after entering Reeves County about 7 miles northwest of Toyahale; rises 18 miles west of Fort Davis, in Davis Mountains, Jeff Davis County; flows northwestward 25 miles. Fort Davis topographic map.

CHERRY CREEK.—Edwards County; small intermittent tributary to West Nueces River (tributary to the Nueces) in southern part of the county; unites with West Nueces River at Dobbs Run; flows southerly 5 miles. Nueces topographic map.

CHERRY CREEK.—Howard and Mitchell counties; rises in northeastern part of Howard County; flows southeasterly about 25 miles into Morgan Creek (tributary to the Colorado) 4 miles west of Colorado.

CHERRY CREEK.—Kerr County; southwest of Comfort, in southeastern part of county; tributary to Guadalupe River.

CHERRY SPRINGS CREEK.—Llano County; an intermittent tributary through Hickory Creek to Llano River and thus to the Colorado in the southwestern part of the county; length, 6 miles. Fredericksburg and Llano topographic maps.

Cherrymusco Creek.—Duval, Webb, and La Salle counties; small tributary flowing northwesterly 10 miles into Nueces River near the corner of Duval, Webb, and La Salle counties.

Chiamon Bayou.—San Augustine County; rises in eastern part of county; flows southwesterly 10 miles into Ayish Bayou (tributary to Angelina River, and thus to the Neches).

Chicken Bayou.—Shelby County; small stream flowing into Tancha Bayou (tributary to Sabine River) near Flat Fork in northern part of county.

Chickinee Creek.—Falls County; rises near Rupee; flows southward 3½ miles into Pond Creek (tributary to the Brazos) in southern part of county. Temple topographic map.

Chicolate Creek.—Dewitt, Victoria, Lavaca, and Jackson counties; rises in the eastern part of Dewitt County, where it is known as the South Chicolate Creek; flows southeastward 9 miles through Dewitt Couny, 3 miles through the north corner of Victoria County, then 7 miles through the south corner of Lavaca County to its junction with Little Brushy Creek, forming Chicolete Creek, thence 4 miles through Jackson County into Lavaca River (tributary to Matagorda Bay and Gulf of Mexico); length, 23 miles.

Chigoe Bayou.—Brazoria and Galveston Counties; rises in Brazoria County, northeastern part; flows northeasterly 1 mile through Brazoria County, then 4 miles through Galveston County into Clear Creek (thence to Clear Lake and thus to Gulf of Mexico through Galveston Bay).

Childress Creek.—Bosque and McLennan counties; rises 5 miles northeast of Clifton, in southern part of Bosque County; flows southeasterly 20 miles into Brazos River 3½ miles north of China Springs. Meridian and Waco topographic maps.

Chilipin Creek.—San Patricio County; rises near Sinton, in the north central part of the county; flows northward and eastward 12 miles into Copano Bay, thence to Gulf of Mexico.

Chiltipin Creek.—Duval and Jim Wells counties; rises in the northeastern part of Duval County; flows southeastward to its junction with Pinias Creek (tributary to Gulf of Mexico through Santa Petronilla Creek and Baffins Bay) in the eastern part of Jim Wells County.

Chimney Creek.—Shackleford County; rises 8 miles west of Albany; flows westerly 14 miles into Clear Fork of Brazos River (tributary to the Brazos) near center of eastern line of Jones County. Anson and Albany topographic maps.

China Creek.—San Saba County; flows into San Saba River (tributary to the Colorado) 2 miles northwest of the town of San Saba, in the eastern part of the county; length, 7 miles. San Saba topographic map.

China Creek.—Val Verde County; small stream in northeastern corner of the county; flows northwesterly 6 miles into Buckleys Creek (tributary through Devils River) to Rio Grande.

China Creek.—Wilbarger and Wichita counties; rises in notheastern part of Wilbarger County; flows through northwestern corner of Wichita County into Red River and thus to the Mississippi; intermittent. Electra topographic map.

China Creek.—Fisher County; rises near Palava; flows northeastward 10 miles into Clear Fork of Brazos River (tributary to the Brazos) 2 miles northwest of Newman; intermittent. Roby topographic map.

CLEAR CREEK.—Erath County; small stream flowing northerly to a point 1 mile south of Palo Pinto-Erath county line, where it enters Big Sunday Creek (tributary through Palo Pinto Creek to Brazos River); length, 5 miles. Stephenville topographic map.

CLEAR CREEK.—Ellis County; small stream flowing into Pecan Creek (tributary to Richland Creek, thence to Trinity River) in southeastern part of county.

CLEAR CREEK.—Gonzales County; rises in the southwestern part of the county; flows easterly 9 miles into Castlemans Fork of Sandies Creek (tributary to Sandies Creek and thus to Guadalupe River) near Nixon.

CLEAR CREEK.—Harris and Galveston counties; rises near Almeda in southwestern part of Harris County; flows southeasterly 26 miles, forming the boundary between Harris and Galveston counties almost this entire length; empties into Galveston Bay through Clear Lake, and thus to Gulf of Mexico; tidal in lower course for about 8 miles. Almeda, Mykawa, Genoa, and Seabrook topographic maps.

CLEAR CREEK.—Montgomery County; rises near Willis in Northern part of county; flows southeasterly 7 miles into West San Jacinto River, thence to San Jacinto River, Galveston Bay and Gulf of Mexico.

CLEAR CREEK.—Montague, Cooke, and Denton counties; rises about 4 miles west of Saint Jo in Montague County; flows southeasterly 40 miles into Elm Fork of Trinity River (tributary to the Trinity) about 5 miles northeast of the town of Denton in Denton County. Montague and Gainesville topographic maps.

CLEAR CREEK.—Newton County; rises about a mile east of Burkeville; small stream flowing into McGraw Creek (tributary to Little Cow Creek, thence to Sabine River) in northern part of county.

CLEAR CREEK.—Newton County; rises about 3 miles northeast of Farrsville; flows southeasterly 5 miles into Yellow Bayou (tributary to Little Cow Creek and thus to the Sabine) about 2 miles south of Burkeville.

CLEAR CREEK.—San Augustine County; rises in southern part of county; flows southeasterly 12 miles into Angelina River (tributary to Neches River) south of White City.

CLEAR CREEK.—Upshur County; rises in southeastern part of county; flows northwesterly 7 miles into Little Cypress Creek (tributary to Caddo Lake, thence to Red River, and thus to the Mississippi) southeast of Gilmer.

CLEAR CREEK.—Upshur County; rises about 3 miles southwest of Gilmer in central part of county; flows northeasterly 5 miles into Keley Creek (tributary to Little Cypress Creek, thence through Caddo Lake to Red River and thus to the Mississippi) about 2½ miles north of Gilmer.

CLEAR CREEK.—Williamson County; a stream rising near western county line and flowing southeasterly 4½ miles into North Fork of San Gabriel River (tributary to San Gabriel River and thus through Little River to the Brazos) 2½ miles south of Gabriel Mills. Georgetown topographic map.

CLEAR FORK OF TRINITY RIVER.—Jack, Parker, and Tarrant counties; rises approximately 2 miles south of Gibtown in the extreme southeastern corner of Jack County; flows southeasterly 56 miles into West Fork of Trinity River (tributary to the Trinity) at Fort Worth in central part of Tarrant County. Weatherford and Fort Worth topographic maps.

CLEASON CREEK.—Falls County; rises near Perry in northern part of county; flows southerly 12 miles into Brazos River.

CLEMENS CREEK.—Gonzales County; rises east of Belmont; in northwestern part of county; small intermittent stream flowing into Guadalupe River. San Marcos topographic map.

Click Branch.—Llano County; a small stream 3 miles in length flowing into Barnett Branch, and thus through Sandy Creek to the Colorado in the southeastern part of the county. Llano topographic map.

Click Creek.—Lamar County; rises at Paris in central part of county; flows southeasterly 17 miles into North Sulphur River (tributary to Sulphur River and thus through Red River to the Mississippi) in the southeastern part of the county at the southern boundary.

Clifty Creek.—Brazos County; a small stream flowing into Big Creek (tributary to Navasto River and thus to the Brazos) south of Millican in southern part of county. Navasota topographic map.

Clouds Bayou.—Galveston County; rises in the western part of the county; flows southwesterly 3 miles into Halls Bayou, thence to West Galveston Bay and Gulf of Mexico.

Cloice Branch.—McLennan County; small tributary to South Bosque River northwest of Hewitt; partially intermittent. Temple topographic map.

Coal Creek.—Gillespie and Llano counties; rises near Mount Hudson in the northern part of Gillespie County; flows northward 12 miles to its junction with Sandy Creek (tributary to the Colorado) 2½ miles south of Click in southeastern part of Llano County. Fredericksburg and Llano topographic maps.

Coal Kiln Draw.—Sutton County; small intermittent stream 4 miles long in the northeastern part of the county; flows into Terrett Draw, and thus to the San Saba (tributary to Colorado River). Fort McKavette topographic map.

Cob Jones Creek.—Franklin County; a stream 6 miles long flowing southeasterly through northeastern part of county into Whiteoak Bayou (tributary to Sulphur River and thus through Red River to the Mississippi).

Cobb Creek.—Hill County; rises 2 miles west of Jessie; in southern part of county; flows southwestward 8 miles into Aquilla Creek (tributary to Brazos River) 2 miles northeast of Aquilla. Waco topographic map.

Cobb Gulley.—Harris County; rises 2 miles southeast of Humble in eastern part of county; flows circuitously southeastward, northeastward, and northerly 5 miles into San Jacinto River and thus to the Gulf of Mexico. Harmaston and Moonshine Hill topographic maps.

Cochino Bayou or Hog Creek.—Houston and Trinity counties; rises in the eastern part of Houston County; flows easterly 17 miles into Neches River in northern part of Trinity County about one-half mile below the Eastern Texas Railroad bridge.

Coffee Branch.—Ellis County; small stream flowing into North Fork of Pecan Creek (tributary to Pecan and Richland Creeks, thence to Trinity River) east of Files Valley in southwestern part of county. Cleburne topographic map.

Coffee or Lacy Creek.—Glasscock and Sterling counties; rises near Garden City in the central part of Glasscock County; flows eastward 27 miles into North Concho River (tributary through Concho River to the Colorado) 4 miles west of Sterling City near the center of Sterling County.

Coffee Creek.—Palo Pinto County; a northerly flowing stream joining Brazos River at a point 2 miles southeast of Brazos in southeastern part of county; length, 3 miles. Palo Pinto topographic map.

Coffeemill Creek.—Fannin County; rises about 12 miles north of the town of Bonham; flows easterly 11 miles into Bois d'Arc Creek (tributary to Red River, which discharges into the Mississippi).

COKER CREEK.—Bandera County; an intermittent stream in the eastern part of the county; unites with Medina River (tributary to the San Antonio and thus to Guadalupe River) 5 miles northwest of Bandera.

COLE CREEK.—Jasper, Orange, and Newton counties; rises in southeastern part of Jasper County; flows southeasterly into Sabine River.

COLES CREEK.—Washington County; rises near Brenham; flows southerly 10 miles into East Fork of Mill Creek (tributary to Mill Creek and thus to Brazos River).

COLE CREEK.—Wichita County; rises 4½ miles northwest of Electra in northern part of county; flows northeasterly about 8 miles into Red River (tributary to the Mississippi); partially intermittent. Barwise School topographic map.

COLES CREEK.—Washington County; rises in northeastern corner of county; flows easterly to a point near Old Washington where it enters Brazos River; length, 7 miles. Gay Hill and Navasota topographic maps.

COLETO CREEK.—Dewitt, Goliad, and Victoria counties; formed in the southwestern part of Dewitt County by the junction of east and west branches; flows southeasterly 9 miles through Dewitt County forming the boundary between Dewitt and Goliad counties for 8 miles, along the boundary of Victoria and Goliad counties for 17 miles, thence 11 miles through Victoria County into Guadalupe River about 6 miles below Victoria.

COLETO CREEK, WEST FORK.—Dewitt County; southwestern part; flows southeasterly 9 miles to its junction with East Fork, 4 miles southwest of Yorktown to form Coleto Creek (tributary to Guadalupe River).

COLETO CREEK, EAST FORK.—Karnes and Dewitt counties; rises in the northeastern part of Karnes County; flows southeasterly 2 miles through Karnes County, then 11 miles through Dewitt to its junction with the West Fork 4 miles southwest of Yorktown where it forms Coleto Creek (tributary to Guadalupe River).

COLETO CREEK, WEST BRANCH (EIGHTEENMILE OR MILBY CREEK).—Dewitt and Goliad counties; rises near the southern line of Dewitt County; flows southeasterly 12 miles into Coleto Creek (tributary to the Guadalupe).

COLD CREEK.—San Saba and Llano counties; rises 11 miles southwest of Cherokee in the southern part of San Saba County; flows southward 9 miles into San Fernando Creek (tributary through Llano River to the Colorado) 6 miles southwest of Valley Spring. Llano topographic map.

COLD SPRING CREEK.—Mason and Llano counties; intermittent; rises 2 miles west of Loyal Valley in the southeastern part of Mason County; flows northeastward 8 miles into Hickory Creek (tributary through Llano River to the Colorado). Mason and Llano topographic maps.

COLDWATER CREEK.—Fayette County; small intermittent stream in the southwestern part of the county; flows southeasterly 5 miles to its junction with Rocky Creek (tributary to Mulberry Creek, Navidad and Lavaca rivers and thus to Gulf of Mexico). Flatonia topographic map.

COLDWATER CREEK.—Hutchinson County; rises 9 miles northwest of Plemons; flows southeasterly 10 miles into Canadian River (which discharges into the Mississippi through Arkansas River) 3½ miles northeast of Plemons in central part of county; intermittent.

COLONY CREEK.—Eastland County; rises near north line of county; flows southeasterly through Merriman into Leon River (tributary through Little River to the Brazos) 4½ miles southeast of Merriman. Breckenridge and Eastland topographic maps.

COLORADO RIVER, NORTH FORK.—Borden and Scurry counties; rises in the northern part of Borden County; flows southeasterly about 35 miles into Colorado River southeast of Knapp in southwestern corner of Scurry County.

COLSTON DRAW.—Menard, Kimble, and Schleicher counties; small intermittent stream flowing north into Terrett Draw (tributary to San Saba and Colorado rivers) 3 miles south of Fort McKavett in the southeastern part of Schleicher County. Fort McKavett topographic map.

COLORADO RIVER (OF TEXAS).—Rises in Dawson County near the New Mexico-Texas line; flows in a southeasterly course approximately 600 miles, passes through Ballinger, Austin, Columbus, and Bay City, and enters Matagorda Bay (an arm of Gulf of Mexico) in the south central part of Matagorda County near Matagorda; area of drainage basin in Texas, 37,800 square miles; possibly some contributory drainage area in southeastern New Mexico to Concho River; principal tributaries, Pedernales, Llano, San Saba, and Concho rivers, and Pecan Bayou. The Llano and Concho contribute a large part of the perennial flow.

The country drained below Austin is flat, alluvial bottom land, valuable for agricultural purposes. Although some lands above this point are tillable, in general the stream passes through a limestone formation and the catchment may be classed as rough. Several suitable reservoir sites are available, in the upper drainage basin, for storage of flood waters, but none have been developed above Austin. In Colorado, Wharton, and Matagorda counties large areas of rice are irrigated by pumping water from the stream. Along the river are distributed several dams, the most important of which are: Austin dam, just above the city of Austin at the mouth of a canyon-like channel through the limestone formation; and the San Angelo Light & Power Co.'s dam on South Concho River at San Angelo.

Gaging stations: Bronte, Ballinger, Chadwick, Marble Falls, Austin, Columbus and Wharton.

Precipitation varies from 10 inches in the northwestern part of the catchment to 55 inches near the coast.

Hayrick, Ballinger, Eden, Brady, San Saba, Lampasas, Burnet, Blanco, Austin, Bastrop, and Flatonia topographic maps.

See Second Report of Texas Board of Water Engineers for list of certified filings of appropriations for use of water in this drainage.

COLLARDS CREEK.—Madison County; small stream flowing into Bidais Creek (tributary to the Trinity) in the southeastern part of the county.

COLLEY CREEK.—Cass County; rises about 3½ miles north of Linden in central part of county; flows southeasterly 7 miles into Frazier Creek (tributary to Caddo Lake and thus through Red River to the Mississippi) about 5 miles northeast of Linden.

COLLEGE MOUND CREEK.—Kaufman County; small stream flowing into Mustang Creek (tributary to Cedar Creek, thence to Trinity River) east of Kaufman in central part of county.

COLLEGE MOUND FORK OF CEDAR CREEK.—Kaufman County; rises about 1 mile northeast of the town of Kaufman; flows southwesterly 6 miles into Cedar Creek (tributary to Trinity River) about 4 miles south of Kaufman.

COLLINS CREEK.—Shackleford County; rises 9 miles west of Fort Griffin in northern part of county; flows easterly into Clear Fork of Brazos River (tributary to the Brazos) at Fort Griffin. Albany topographic map.

COLLIER CREEK.—Red River County; rises 5 miles northwest of Annona in eastern part of county; flows southerly 8 miles into Kickapoo Creek (tributary to Cuthand Creek and thus through Sulphur and Red Rivers to the Mississippi).

COLLOM SPRING BRANCH.—Bowie County; rises about 5 miles southeast of New Boston; flows into Rock Creek (tributary through Langum Creek to Sulphur River and thus through Red River to the Mississippi). New Boston topographic map.

COLLUMS SPRING BRANCH.—Bowie County; small stream about 4 miles north of Hooks post office in northeastern part of county; flows into Big Lake. (Red and Mississippi rivers drainage basins).

COMANCHE CREEK.—Anderson County; stream flowing southeasterly, then northeasterly into Ioni Creek (tributary to Neches River) in the southeastern part of the county; length, 9 miles.

COMANCHE CREEK.—Bexar County; small intermittent stream in southern part of county 12 miles south of San Antonio; flows into Leon Creek (tributary through Medina River to the San Antonio and thus to Guadalupe River) 1½ miles above its mouth. San Antonio topographic map.

COMANCHE CREEK.—Blanco and Llano counties; rises in the northern part of Blanco County; flows northward 11 miles into Sandy Creek (tributary to Colorado River) 2 miles southeast of Click in southeastern part of Llano County. Fredericksburg and Llano topographic maps.

COMANCHE CREEK.—Mason County; rises 4 miles north of the town of Mason in the central part of the county; flows southeastward 14 miles through Mason into Llano River (tributary to the Colorado) 2 miles southwest of Hedwigs Hill. Mason topographic map.

COMANCHE CREEK.—Pecos County; rises about 35 miles southwest of Fort Stockton; flows northerly 25 miles to Fort Stockton where it unites with Comanche Springs to form Comanche Creek (main stream); from this point it takes a northeasterly course 25 miles to its junction with Pecos River (tributary to Rio Grande) 8 miles east of Buena Vista.

COMANCHE CREEK.—San Saba County; a small tributary to Colorado River to the east of Indian Creek in the southwestern part of the county; length, 7 miles. Brownwood and San Saba topographic maps.

COMANCHE CREEK.—Zavalla County; small stream 15 miles long flowing northeastward to its junction with Elm Creek (tributary to the Nueces) in southwestern part of county.

COMAL RIVER.—Comal County; perennial stream formed about 1 mile northwest of New Braunfels by a series of large springs; flows southeasterly 2 miles into Guadalupe River in the edge of the city of New Braunfels. Flood water channel extends southwest for several miles above springs. This stream is important for its power value and water supply for municipal and irrigation purposes.

COMMISSIONERS CREEK.—Bandera County; small tributary to Hondo River (thence to the Nueces through Frio River) in the southern part of the county; flows southwestward 5 miles.

COMOJELANO CREEK.—San Augustine County; rises in southwestern part of county; flows southeasterly 7 miles into Ayish Bayou, and thus to Angelina and Neches rivers.

CONCEPCION CREEK.—Duval County; rises on Duval-Webb county line near Moglia; flows southeastward 35 miles into Olmos Creek (thence to Gulf of Mexico through Baffins Bay) at Santa Cruz.

CONEJOS CREEK.—Zavalla County; small intermittent tributary to Muela Creek (thence to Nueces River through Chapparosa, Turkey, and Elm creeks) in the northwestern part of Zavalla County; length, 3 miles. Brackett topographic map.

CONCHO RIVER.—Tom Green and Concho counties; formed at the city of San Angelo, Tom Green County, by junction of North and South Concho rivers; flows easterly 24 miles through Tom Green County, then 29 miles through Concho County into Colorado River 12 miles northeast of Paint Rock, in the northwestern part of Concho County.

Above San Angelo the waters of the tributaries are used extensively for irrigation and municipal operations, and in vicinity of Paint Rock and south of Miles small areas are also irrigated; a dam has been constructed at San Angelo on South Concho River by the San Angelo Light & Power Co. to impound water for city use. Several smaller dams for storage purposes have been constructed, but there are no water-power developments in the basin. Area of drainage basin, 12,000 square miles (includes North and South Concho rivers). Gaging stations at San Angelo and near Paint Rock. Sherwood, Hayrick, San Angelo, Ballinger, and Eden topographic maps.

See Second Report of Texas Board of Water Engineers for list of certified filings of appropriations for uses of water.

CONGLOMERATE CREEK.—Donley County; a stream 3 miles long flowing southerly through northeastern part of county into Whitefish Creek (tributary to Salt Fork of Red River, thence to Prairie Dog Town Fork of the Red and thus to the Mississippi through Red River).

CONKLIN CREEK.—Childress County; rises about 2 miles north of Childress in central part of county; flows northerly 9 miles into Prairie Dog Town Fork of Red River, thence to Red River and thus to the Mississippi.

CONNER CREEK.—Houston County; a stream 6 miles long flowing easterly into Neches River in northeastern part of the county.

CONNERS CREEK.—Young County; a stream in northeast corner of county; flows southerly 7 miles into Brazos River southeast of Graham.

CONTRARY CREEK.—Hood County; an intermittent stream rising at Neri and flowing northerly 4 miles into Brazos River southeast of Granbury. Granbury topographic map.

COOK SLOUGH.—Zavalla County; a small intermittent tributary to Leona River (thence to the Nueces through Frio River) in the northern part of the county; length, 7 miles. Uvalde topographic map.

COOKS SLOUGH.—Uvalde County; an intermittent tributary to Leona River thence to the Nueces through Frio River) in the west central part of county; rises 10 miles north of Uvalde on south side of Green Mountain; flows southeasterly 17 miles. Uvalde topographic map.

COON CREEK.—Bosque County; rises 3 miles west of Merrivale; flows northeasterly 8 miles into Brazos River in southeastern part of county. Waco topographic map.

COON CREEK.—Fort Bend County; rises midway between Rosenberg and Beasley in central part of county; flows southeasterly 5 miles into Cottonwood Creek (tributary through Big Creek to Brazos River).

COOPERS CREEK.—Garza County; rises 5 miles southeast of Post in southern part of county; flows southerly 9 miles into Double Mountain Fork of Brazos River (tributary to Brazos River).

COOPER CREEK.—Kent County; rises in southern part of county; flows northerly 10 miles into Double Mountain Fork of Brazos River (tributary to Brazos River).

COOSE BRANCH.—Erath County; rises 2 miles northeast of Lingleville in western part of county; flows southeasterly 5 miles into South Bosque River (tributary to the Bosque). Stephenville topographic map.

COPANO CREEK.—Refugio County; rises southeast of Vidauri in central part of county; flows southward 8 miles through Refugio County, then 7 miles along the boundary of Refugio and Aransas counties into Copano Bay, an arm of Gulf of Mexico.

COPELAND CREEK.—Montague County; joins Elm Fork of Trinity River (tributary to the Trinity) about 3 miles southeast of Saint Jo; short intermittent stream. Gainesville topographic map.

COPPERAS CREEK.—Bastrop County; rises 4 miles southeast of Bastrop in central part of county; flows into Colorado River; length, 4 miles. Bastrop topographic map.

COPPERAS CREEK.—Caldwell, Bastrop and Gonzales counties; rises east of Delhi in southern part of Bastrop County; flows through eastern corner of Caldwell County to its junction with Peach Creek (tributary to the Guadalupe) 4 miles east of Waelder. Flatonia topographic map.

COPPERAS CREEK.—Caldwell County; rises south of Tilmon in southern part of County; flows into Plum Creek and thus through San Marcos River to the Guadalupe; intermittent. San Marcos topographic map.

COPPERAS OR RUSH CREEK.—Comanche and Eastland counties; rises at Rising Star in southern part of Eastland County; flows southeastward 32 miles into Leon River (tributary to Little River and thus to the Brazos) 7 miles northeast of Comanche near the center of Comanche County. Eastland and Brownwood topograhic maps.

COPPERAS CREEK.—Kimble County; small stream in northwestern part of county flowing 6 miles to its junction with North Llano River (tributary through Llano River to the Colorado). Fort McKavett topographic map.

COPPERAS CREEK.—Robertson County; small stream flowing into Big Cedar Creek (which discharges into Brazos River through the Navasota) northwest of Wheelock in southeastern part of county; length, 3 miles.

CORD WOOD CREEK.—Shackelford County; a stream flowing easterly 5 miles into Deep Creek (which discharges into Hubbard and Gonzales creeks and thus through Clear Fork of Brazos River to the Brazos) 1 mile west of Hulltown in southern part of county. Albany topographic map.

CORNELIUS CREEK.—Grayson County; rises 6 miles north of Whitewright in eastern part of county; flows northwestward 5½ miles into Mill Creek (tributary to Choctaw Creek and thus through Red River to the Mississippi) about 7½ miles southeast of Denison.

CORN CREEK.—McCulloch County; small tributary to Colorado River in northeastern part of the county northwest of Cowboy; length, 10 miles. Brady topographic map.

CORRALL CREEK.—Bowie County; a small intermittent stream entering Howard Creek (tributary to Hurricane Creek, and thus through Sulphur and Red rivers to the Mississippi) about 3 miles southwest of Taxarkana in eastern part of county. Texarkana topographic map.

CORRALL CREEK.—Potter County; a stream rising in northwestern part of county and flowing southwesterly 5 miles into Canadian River (tributary to Arkansas River and thus to the Mississippi) 1½ miles east of Amy.

CORRELL CREEK.—Irion and Reagan counties; small stream flowing southward 9 miles along the Irion-Reagan county line to its junction with Middle Concho River (tributary to South Concho River, and thus through the Concho to Colorado River) in northwestern part of Irion County.

CORWINS CREEK.—Borden County; a stream 11 miles long flowing through the southeastern part of the county into Colorado River.

CORYELL CREEK.—Coryell County; rises near Pancake in extreme northern part of county; flows southeasterly 24 miles into Leon River (tributary to Little River and thus to the Brazos) one mile south of Pecan Grove. Meridian and Gatesville topographic maps.

COTTON CREEK.—Young County; flows southerly 5 miles into Brazos River 2 miles northwest of New Castle in western part of county.

COTTON CREEK.—Jefferson County; small stream rising near Nome in northwestern part of county and flowing northeasterly into Pine Island Bayou tributary to Neches River) 2 miles west of Wertbury.

COTTON PATCH BAYOU.—Harris County; small tidal bayou in the southeastern part of the county, northeast of Pasadena; flows northeasterly about 2 miles into Ship Channel (Buffalo Bayou) thence to Galveston Bay and Gulf of Mexico.

COTTONWOOD ARROYO.—Oldham and Potter counties; an intermittent stream 6 miles long flowing northeasterly to Canadian River (tributary to Arkansas River and thus to the Mississippi) 5 miles southeast of Tascosa, near line of Potter and Oldham counties.

COTTONWOOD CREEK.—Armstrong and Donley counties; rises in southeastern part of Armstrong County; flows easterly 9 miles into Mulberry Creek (tributary to Prairie Dog Town Fork of Red River, and thus through Red River to the Mississippi) in southwestern part of Donley County.

COTTONWOOD CREEK.—Armstrong County; rises in western part of county; flows eastward 3 miles into Dry Creek (tributary to Prairie Dog Town Fork of Red River and thus to the Red and Mississippi rivers).

COTTONWOOD CREEK.—Armstrong County; rises about 7 miles southeast of Claude in northeastern part of county; flows easterly 9 miles into Salt Fork of Red River (tributary to Prairie Dog Town Fork of Red River and thus through the Red to Mississippi River) in northern part of the county about three-fourths mile west of eastern boundary of county.

COTTONWOOD CREEK.—Bell County; small stream 10 miles long flowing southeasterly into Big Elm Creek (tributary through Little River to the Brazos) 5 miles south of Oenaville. Temple topographic map.

COTTONWOOD CREEK.—Brewster County; a small stream uniting with Rough Run (tributary to Terlingua Creek and thus to Rio Grande) 8 miles above mouth of Rough Run in southern part of county. Chisos Mountains topographic map.

COTTONWOOD CREEK.—Collingsworth County; rises in central part of county; flows southerly 5 miles into Salt Fork of Red River (tributary through Prairie Dog Town Fork of Red River to the Red and thus to Mississippi).

COTTONWOOD CREEK.—Collin, Dallas, and Rockwall counties; rises in the southeastern corner of Collin County; flows 5 miles southeasterly through the corners of Dallas and Rockwall counties into the East Fork of Trinity River (tributary to Trinity River). Dallas and Rockwall topographic maps.

COTTONWOOD CREEK.—Cottle County; rises about 5 miles northeast of Paducah; flows southeasterly 10 miles into North Wichita River (tributary to Wichita River and thus through Red River to the Mississippi).

COTTONWOOD CREEK.—Coryell County; a small intermittent stream flowing northeasterly 7 miles into Leon River (tributary to Little River and thus to the Brazos) 2 miles south of Gatesville. Gatesville topographic map.

COTTONWOOD CREEK.—Coryell County; rises near Twin Mountains in southern part of county; flows northeasterly 8 miles into Cowhouse Creek (tributary to Leon River, and thus through Little River to the Brazos) 6 miles southeast of Pidcoke. Gatesville topographic map.

COTTONWOOD CREEK.—Dallas County; small tributary to Trinity River north of Wilmer in southeastern part of county. Dallas topographic map.

COTTONWOOD CREEK.—Dewitt and Victoria counties; rises in south-central part of Dewitt County; flows southeasterly 17 miles through Dewitt County, then 4 miles through Victoria County into Coleto Creek (tributary to Guadalupe River) in western part of Victoria County.

COTTONWOOD CREEK.—Dickens County; rises 3 miles west of Hay Stack Mountain; flows southeasterly 10 miles into Duck Creek (tributary through Salt Fork of Brazos River to the Brazos) 5 miles southwest of Dickens in southern part of county.

COTTONWOOD CREEK.—Ellis County; small stream flowing into Pecan Creek (tributary to Richland Creek, thence to the Trinity) in the southwestern part of the county.

COTTONWOOD CREEK.—Ellis County; small stream flowing into Brushy Creek (tributary to Red Oak Creek, and thus to the Trinity) in the northeastern part of the county. Dallas topographic map.

COTTONWOOD CREEK.—Ellis County; flows northerly 6 miles into Mountain Creek (which discharges into Trinity River through West Fork of the Trinity) in northwestern part of county. Cleburne and Fort Worth topographic maps.

COTTONWOOD CREEK.—Erath County; rises at the town of Dublin; flows easterly 8 miles into Green Creek (tributary to Bosque River and thus to the Brazos) 1 mile northeast of Alexander in southern part of county. Stephenville topographic map.

COTTONWOOD CREEK.—Fisher County; an intermittent stream flowing southward 3 miles to its junction with Sweetwater Creek (tributary through Clear Fork of Brazos River to the Brazos) near Eskota. Roby topographic map.

COTTONWOOD CREEK.—Fisher County; rises near Claytonville; flows northeasterly 20 miles into Clear Fork of Brazos River (tributary to the Brazos) 4 miles north of Roby in central part of county. Roby topographic map.

COTTONWOOD CREEK.—Gillespie County; a small stream 3 miles in length flowing into White Oak Creek, and thus through the Pedernales to Colorado River in the southwestern part of county. Kerrville topographic map.

COTTONWOOD CREEK.—Ford Bend County; rises near Beasley in western part of county; flows easterly 9 miles into Big Creek and thus to Brazos River.

COTTONWOOD CREEK.—Guadalupe County; small stream joining Guadalupe River about 3 miles south of Seguin. San Marcos topographic map.

COTTONWOOD CREEK.—Hays and Guadalupe counties; rises about 3 miles south of the town of San Marcos; flows southeasterly 3 miles through Hays County, then 8 miles through Guadalupe County where it joins York Creek (tributary to San Marcos River and thus to the Guadalupe) about 4 miles southwest of Staples. San Marcos topographic map.

COTTONWOOD CREEK.—Hill County; small stream flowing to a point north of Itasca in northern part of county, where it enters Island Creek, thence to North Fork of Pecan Creek (which discharges into Trinity River through Pecan and Richland creeks). Cleburne topographic map.

COTTONWOOD CREEK.—Hill County; rises 2 miles southeast of Covington in northern part of county; flows southward 9 miles, passing through the village of Osceola, to a point 1½ miles west of Woodbury where it enters Aquilla Creek and thence to Brazos River. Cleburne topographic map.

COTTONWOOD CREEK.—Hutchinson County; an intermittent stream 5 miles long flowing southerly to its junction with Canadian River (tributary to Arkansas River and thus to the Mississippi) 5 miles southwest of Plemons in central part of county.

COTTONWOOD CREEK.—Jones County; a partially intermitent stream rising 6 miles east of Anson and flowing easterly 10 miles into Clear Ford of Brazos River (which discharges into the Brazos) north of Lueders near western Shackelford county line. Anson topographic map.

COTTONWOOD CREEK.—Johnson and Ellis Counties; rises 4 miles east of Alvarado in the eastern part of Johnson County; flows southeasterly 8 miles into Onion Creek (tributary through North Fork of Pecan Creek to Pecan Creek, thence to Trinity River) 3 miles north of Auburn in the western part of the county. Cleburne topographic map.

COTTONWOOD CREEK.—Karnes County; small stream flowing through the southern part of the county into Hondo Creek (tributary through San Antonio River to the Guadalupe).

COTTONWOOD CREEK.—King County; rises in northwestern part of county; flows northeasterly 4 miles into North Wichita River (tributary to Wichita River and thus through Red River to the Mississippi).

COTTONWOOD CREEK.—Leon County; a small stream flowing into Keechi Creek (tributary to Trinity River) about 5 miles east of Jewett.

COTTONWOOD CREEK.—Lipscomb County; an intermittent stream flowing northeasterly 10 miles, joining Wolf Creek (tributary through North Fork of Canadian River to the Canadian and thus through the Arkansas to the Mississippi) 4 miles east of Lipscomb in the central part of county.

COTTONWOOD CREEK.—Llano County; a small intermittent stream 3 miles long, in the southwestern part of the county; connects with Hickory Creek (tributary to Llano River and thus to the Colorado). Llano topographic map.

COTTONWOOD CREEK.—Llano County; an intermittent stream 4 miles long flowing into Bullhead Creek (tributary to Hickory Creek and thus through Llano River to the Colorado) north of Starkes, in the southwestern part of county. Llano topographic map.

COTTONWOOD CREEK.—Llano County; a stream 4 miles in length flowing into Sandy Creek (tributary to Colorado River) east of Click, in the southeastern part of the county. Llano topographic map.

COTTONWOOD CREEK.—Llano County; a stream 4 miles long flowing through the southern part of the county to its junction with Sandy Creek (tributary to the Colorado) near Moss Ranch. Llano topographic map.

COTTONWOOD CREEK.—Matagorda County; rises in the central part of the county; flows southeasterly 4 miles into Prairie Creeek, and thus to Live Oak Creek, Matagorda Bay, and Gulf of Mexico.

COTTONWOOD CREEK.—McLennan County; rises 4 miles southwest of Waco; flows northeasterly 8 miles into Brazos River. Waco topographic map.

COTTONWOOD CREEK.—Montague County; rises about 2 miles northeast of Bonito, in norheastern part of county; flows northerly 13 miles into Red River (tributary to the Mississippi) about 4 miles southeast of Old Spanish Fort. Montague topographic map.

COTTONWOOD CREEK.—Motley County; a stream 4 miles long flowing northerly through northern part of county to Hornica Creek, thence to Pease River, and thus through Red River to the Mississippi.

COTTONWOOD CREEK.—Navarro County; a stream flowing into Richland Creek (tributary to Trinity River) west of the town of Corsicana, in west central part of county.

COTTONWOOD CREEK.—Nolan County; rises northeast of Hylton, in the southeastern part of the county; flows 5 miles into Spring Creek and thus through Valley Creek to the Colorado. Sweetwater topographic map.

COTTONWOOD CREEK.—Parker and Hood Counties; joins Kickapoo Creek (tributary to Brazos River) a mile southwest of Buckner; length, 5 miles. Weatherford topographic map.

COTTONWOOD CREEK.—San Saba County; a small tributary to Colorado River south of Regency, in the northeastern part of county; length, 9 miles. San Saba topographic map.

COTTONWOOD CREEK.—Scurry County; rises 8 miles northeast of Snyder, in central part of county; flows northeasterly 5 miles into Rockwall Creek (tributary through Rough Creek to Double Mountain Fork of Brazos River, thence to the Brazos) in northeast part of county.

COTTONWOOD CREEK.—Stephens County; a stream 4 miles long flowing easterly into North Palo Pinto Creek (which discharges through Palo Pinto Creek into Brazos River) 5 miles north of Ranger, in southeastern part of county. Breckenridge topographic map.

COTTONWOOD CREEK.—Stonewall and Kent counties; a small stream flowing northeasterly into Croton Creek (tributary to Brazos River); length, 3 miles.

COTTONWOOD CREEK.—Tarrant and Dallas counties; rises about 2 miles southeast of Arlington, in Tarrant County; flows northeasterly 8 miles into Mountain Creek (tributary to West Fork of Trinity River and thus to the Trinity) about 3 miles southeast of Grand Prairie, in Dallas County. Fort Worth and Dallas topographic maps.

COTTONWOOD CREEK.—Travis County; rises 2 miles west of Rices Crossing, in eastern part of county; flows southerly 11 miles into Wilbarger Creek and thus to Colorado River. Austin and Bastrop topographic maps.

COTTONWOOD DRAW.—Brewster County; an intermittent stream 3 miles long entering Tornillo Creek (tributary to Rio Grande) 15 miles northwest of Boquillas, in southern part of county. Chisos Mountains topographic map.

COTTONWOOD MOTT CREEK.—Motley County; rises about 3 miles northeast of Lyman, in western part of county; flows northeasterly 6 miles into Middle Pease River (tributary to Pease River and thus through Red River to the Mississippi) about 9 miles northwest of Matador.

COUNCIL BRANCH.—Erath County; a southeastward flowing stream 3 miles long, joining South Bosque River (tributary to Bosque River and thus to the Brazos) north of Lingleville, in western part of county. Stephensville topographic map.

COUNCIL CREEK.—Burnet County; stream 6 miles long east of Bluffton in northwestern part of the county; flows into North Fork of Morgan Creek and thus to the Colorado. Burnet topographic map.

COUNTS CREEK.—Erath County; a stream 8 miles long flowing southeasterly to a point 2 miles east of Morgans Mill, where it enters North Paluxy Creek (tributary to Paluxy Creek and thus to the Brazos) in northern part of county. Stephenville topographic map.

COVE CREEK.—Stephens and Young counties; an intermittent stream rising in the northeastern corner of Stephens County and flowing northeasterly 6 miles into Brazos River. Breckenridge topographic map.

COW BAYOU.—Falls and McLennan counties; formed by the junction of North and South Coy bayous 1 mile north of Mooresville; from thence the stream flows easterly 12 miles into Brazos River, 6 miles northwest of Marlin. Temple topographic map.

Cow Bayou.—Jasper, Newton, and Orange counties; rises in southeastern part of Jasper County; flows southeasterly 28 miles into Sabine River in southern part of Orange County about 5 miles south of Orange.

Cow Branch.—Kent and Scurry counties; rises in northeastern part of Scurry County; flows easterly into Double Mountain Fork of Brazos River (tributary to Brazos River); length, 4 miles.

Cow Branch.—Runnels County; a stream 7 miles long joining Mustang Creek (tributary to Colorado River) 3 miles northeast of Norwood in the southeastern part of the county. Ballinger topographic map.

Cow Creek.—Brazoria and Fort Bend counties; rises near Demon in western part of Brazoria County; flows easterly 8 miles along the boundary line between Brazoria and Fort Bend counties into Brazos River northwest of Otey.

Cow Creek.—Brewster County; rises in eastern part, 12 miles northwest of Bullis Gap; flows southwesterly 15½ miles into San Francisco Creek and thus to Rio Grande; intermittent. Bullis Gap and Indian Wells topographic maps.

Cow Creek.—Burnett and Travis counties; rises 7 miles southeast of the town of Burnet in the southeastern part of Burnet County; flows southeasterly 8 miles through Burnet County, then 12 miles through the northwestern part of Travis County into Colorado River 3 miles east of western Travis County line. Burnet and Blanco topographic maps.

Cow Creek.—Coleman County; a small stream north of Coleman in the northwestern part of the county; flows into Jim Ned Creek (tributary to Pecan Bayou and thus to the Colorado); length, 6 miles. Coleman topographic map.

Cow Creek.—Coke County; an intermittent stream south of Hayrick in the eastern part of the county; flows into Colorado River; length, 7 miles. Hayrick topographic map.

Cow Creek.—Erath and Comanche counties; flows southwestward 10 miles into Armstrong Creek (tributary to Leon River and thus through Little River to the Brazos) northwest of the village of Dublin. Stephenville topographic map.

Cow Creek.—Donley County; a stream 3½ miles long flowing southerly through east central part of county into Salt Fork of Red River (tributary through Prairie Dog Town Fork of the Red to Red River and thus to the Mississippi).

Cow Creek.—Duvall and McMullen counties; rises in the northern part of Duval County; flows northward 5 miles through Duval County, then 12 miles through McMullen County into Nueces River.

Cow Creek.—Kinney County; rises 4 miles south of Newel; flows southwesterly 12 miles into Rio Grande in southwestern corner of county.

Cow Creek.—McCulloch County; north of the town of Brady in northern part of county; flows into Colorado River; length, 18 miles. Brady topographic map.

Cow Creek.—Val Verde County; rises about 6 miles north of Comstock; flows southerly 20 miles to its junction with Rio Grande 6 miles southwest of Feely in southern part of county.

Cowan Creek.—Llano County; a stream 2 miles long southeast of Tow in the northeastern part of the county; flows into Colorado River. Burnet topographic map.

COWHOUSE CREEK.—Mills, Hamilton, Coryell, and Bell counties; rises about 8 miles northeast of Mullen in northern part of Mills County; flows southeasterly 85 miles into Leon River (tributary through Little River to the Brazos) about 3 miles southeast of Sparta in northern part of Bell County. Brownwood, Hamilton, Lampasas, and Gatesville topographic maps.

COWLEACH FORK OF SABINE RIVER.—Hunt County; rises in northwestern part of the county; flows southeasterly 34 miles to its confluence with Caddo Fork of Sabine River (thence to Sabine River) in southeastern part of county.

COWPEN CREEK.—Travis and Caldwell counties; rises in the southern part of Travis County; flows southerly 7 miles into Elm Creek (tributary through Plum Creek to San Marcos River and thus to the Guadalupe) 1 mile southwest of Rogers Branch School. Austin and San Marcos topographic maps.

COX CREEK.—Hunt County; small stream flowing into Cowleach Fork of Sabine River (thence to Sabine River through Caddo Fork of the Sabine) in the north central part of county.

COYOTE CREEK.—Armstrong County; rises in the south central part of county; flows southwesterly 6 miles into Prairie Dog Town Fork of Red River (tributary to Red River and thus to the Mississippi).

COYOTE CREEK.—Runnels County; an intermittent stream rising northwest of Ballinger and flowing into Elm Creek (tributary to the Colorado) in the northwestern part of county; length, 25 miles. Sweetwater, Hayrick, and Ballinger topographic maps.

CRABAPPLE CREEK.—Gillespie and Llano counties; rises 10 miles north of Fredericksburg in northern part of Gillespie County; flows northeastward 20 miles into Sandy Creek 4 miles south of Oxford, Llano County, and thus to Colorado River. Fredericksburg and Llano topographic maps.

CRANE BAYOU.—Jefferson County; small stream in extreme eastern corner of county, about midway between Port Arthur and mouth of Neches River; flows southerly 3½ miles into Sabine Lake, thence through Sabine Pass to the Gulf of Mexico.

CRAWFORD CREEK.—Menard County; a stream flowing through the eastern part of county into San Saba River (tributary to the Colorado); length, 6 miles.

CREENS CREEK.—Fayette County; small stream in northwestern part of county; flows into Rabbs Creek and thus to Colorado River; length, 5 miles.

——— CREEK.—Willacy County; rises in the southern part of the county; flows eastward 20 miles into Laguna Madre, an arm of Gulf of Mexico.

——— CREEK.—Lavaca County; rises in central part of county; flows southeasterly 11 miles into Navidad River and thus to Gulf of Mexico through Lavaca River and Matagorda Bay.

CRIER CREEK.—Colorado County; a small stream in the western part of county, flowing southerly 5 miles, uniting with Colorado River 9 miles northwest of Columbus.

CRISWELL CREEK.—Fayette County; small intermittent stream in northwestern part of county; flows into Colorado River 1 mile northeast of West Point; length, 4 miles. Flatonia topgraphic map.

CROCKERY CREEK.—Hood County; rises south of Lipan near Erath-Hood county line; flows northerly 5 miles into Kickapoo Creek (tributary to Brazos River) 1½ miles northeast of Lipan in northwestern corner of county. Stephenville and Palo Pinto topographic maps.

CROCKETT CREEK.—Anderson County; small stream flowing into Trinity River about 2 miles east of Magnolia in southwestern part of the county.

CROCKETT CREEK.—Lamar County; formed about 6 miles south of Paris in southern part of county by union of East and West Forks of Crockett Creek; flows southeastward into North Sulphur River (tributary through Sulphur River to Red River and thus to the Mississippi) in the southern part of county at the southern boundary line; length, 9 miles.

CROCKETT CREEK, WEST FORK.—Lamar County; rises about 6 miles southwest of Paris in southern part of county; flows southeasterly 3½ miles to a point about 6 miles south of Paris where it joins East Fork of Crockett Creek forming Crockett Creek (tributary to North Sulphur River, thence through Sulphur River to Red River and thus to the Mississippi).

CROCKETT CREEK, EAST FORK.—Lamar County; rises about 4 miles southwest of Paris in southern part of county; flows southward 3 miles to its junction with West Fork of Crockett Creek forming Crockett Creek (tributary to North Sulphur River, Sulphur River, and thus to the Mississippi through Red River) 6 miles south of Paris in southern part of county.

CROOKED BRANCH.—Caldwell County; east of Fentress; an intermittent tributary to San Marcos River, and thus to the Guadalupe. San Marcos topographic map.

CROOKED CREEK.—Edwards County; small intermittent tributary to West Nueces River (thence to the Nueces) in western part of county; flows southeasterly 6 miles. Nueces topographic map.

CROOKED CREEK.—Jack County; small stream flowing through northern part of county into West Fork of Trinity River (tributary to Trinity River) north of Jacksboro.

CROOKED CREEK.—Lavaca County; rises 4 miles east of Sublime near Lavaca-Colorado county line; flows southwestward 9 miles into Navidad River (tributary to Lavaca River, Matagorda Bay, and Gulf of Mexico) 4 miles south of Sublime.

CROOKED CREEK.—Van Zandt County; rises about 3 miles northwest of Canton; flows northeasterly 12 miles into Giladon Creek, thence to Sabine River.

CROOKED CREEK.—Young County; rises near Bryson in eastern part of county; flows westerly 6 miles into Pleasant Creek (tributary to Salt Creek and thus to Brazos River) 2 miles south of Lacy Post Office.

CROOKED LAKE.—Fort Bend County; 5 miles northeast of the town of Richmond in Oyster Bayou drainage (Brazos River drainage); small.

CROSS BRANCH.—Somervell County; an intermittent stream rising in eastern part of county at Seven Knobs and flowing northerly 6 miles into Paluxy Creek (tributary to Brazos River) at Glenrose. Granbury topographic map.

CROSS CREEK.—Williamson and Lee County; rises in the southeast corner of Williamson County; flows southeasterly 10 miles into Second Yegua Creek (tributary through Yegua Creek to Brazos River) 3 miles south of Florence. Bastrop topographic map.

CROSSTIMBER CREEK.—Hopkins County; small stream in northeastern part of county flowing southeasterly 8 miles into Whiteoak Bayou (tributary to Sulphur River and thus through Red River to the Mississippi).

CROTON CREEK, NORTH FORK.—Stonewall and Kent counties; a stream flowing southeasterly 5 miles to its junction with the Middle Fork of Croton Creek to form Croton Creek which discharges into Brazos River through the Salt Fork of the Brazos.

CROTON CREEK.—Stonewall and King counties; rises near Dickens-King county line; flows easterly 36 miles into Brazos River in the northeastern corner of Stonewall County.

CROTON CREEK, MIDDLE FORK.—Stonewall and Kent counties; a stream 7 miles long flowing southeasterly to its union with North Fork of Croton Creek forming Croton Creek (tributary through Salt Fork to Brazos River to the Brazos).

CROTON CREEK.—Stonewall and Kent counties; formed near Stonewall-Kent county line by union of North and Middle forks of Croton Creek; flows easterly 8 miles into Salt Fork of Brazos River (tributary to the Brazos) north of Croton in northwestern part of county.

CROW CREEK.—Cass County; rises near Lone Oak School in northwestern part of county; flows northerly about 2 miles into Sulphur River (tributary to Red River and thus to the Mississippi). Daingerfield topographic map.

CROW CREEK.—Wheeler and Collingsworth counties; rises in southeastern part of Wheeler County; flows southeasterly 8 miles into Elm Fork of Red River (tributary to North Fork of Red River and thus through the Red to Mississippi River) in northeastern part of Collingsworth County.

CROWNEST CREEK.—Coke, Runnels, and Tom Green counties; rises near the line of Coke and Tom Green counties; flows southeastward 18 miles, crosses the southwest corner of Runnels County and joins Concho River (tributary to the Colorado) 5 miles southwest of Miles in the northeastern part of Tom Green County. Hayrick topographic map.

CROW HOLLOW.—Donley County; rises about 2 miles southwest of Rowe; flows northerly 4½ miles into Lake Creek (tributary to Salt Fork of Red River, thence through Prairie Dog Town Fork of the Red to Red River and thus to the Mississippi).

CRUTCHER CREEK.—Bowie County; rises about 5 miles southwest of Texarkana in eastern part of county; flows southerly 4 miles into Sulphur River (tributary to Red River, which discharges into the Mississippi) ½ mile southwest of Sulphur. Texarkana topographic map.

CRYERS BRANCH.—Mills County; a small stream joining Brown Creek (tributary through Pecan Bayou to the Colorado) 4 miles east of Williams Ranch in the central part of the county; length, 6 miles. Brownwood topographic map.

CUERO CREEK.—Dewitt County; small stream in northern part of county; flows southwestward 8 miles to its junction with Guadalupe River 4 miles north of Cuero.

CUEVAS CREEK.—Maverick County; small intermittent stream in southern part of county; formed by the union of two small branches (names not given on map) 3 miles above its mouth; flows westward into Rio Grande 17 miles southeast of the town of Eagle Pass.

CULEBRA CREEK.—Bexar County; rises northwest of San Antonio; flows into Leon Creek (tributary to Medina River and thus through the San Antonio to Guadalupe River); intermittent. San Antonio topographic map.

CULVERS CREEK.—Scurry County; rises in the northwestern part of county; flows southeastward about 37 miles through the town of Snyder into Colorado River near the middle of south county line.

CUMMINS CREEK.—Fayette and Colorado counties; rises in northern part of Fayette County near Ledbetter; flows southeasterly 23 miles through the eastern part of Fayette County, then 14 miles through Colorado County in Colorado River north of Columbus; length, 37 miles.

CUMMINS CREEK.—Ellis and Navarro counties; rises south of Ennis in southeastern part of Ellis County; flows southerly to its unction with Pecan Creek (tributary through Richland Creek to Trinity River) in the northeastern part of Navarro County.

CUNDIFF CREEK.—Jack County; joins West Fork of Trinity River (tributary to the Trinity) northeast of Jacksboro in the northeastern part of county.

CURLOW LAKES.—Dallam County; northeast of Texline in northwestern part of county between Mustang and Rabbit Ear Creek drainages; very small.

CURRY CREEK, MIDDLE PRONG.—Kendall County; head of Curry Creek (tributary to Guadalupe River); joins East and West Prong of Curry Creek to form Curry Creek.

CURRY CREEK, EAST PRONG.—Kendall County; headwater tributary to Curry Creek (thence to Guadalupe River) near Kendalia in northeastern part of county. Curry Creek formed by confluence with Middle and West Prong of Curry Creek.

CURRY CREEK.—Kendall County; rises in the northeastern part of county; flows southeasterly 15 miles entering Guadalupe River at its intersection with the southeastern boundary of the county.

CURRY CREEK, WEST PRONG.—Kendall County; rises near Kendalia in northeastern part of the county; headwater stream uniting with East and Middle Prongs of Curry Creek to form Curry Creek (tributary to Guadalupe River).

CURRYCOMB BRANCH.—Eastland and Comanche counties; rises 2 miles northeast of Jewell; flows southeasterly 6 miles into Sabanna River (tributary through Leon and Little rivers to the Brazos) 3½ miles southeast of Jewell in northern part of Comanche County. Eastland topographic map.

CUSH CREEK.—Matagorda County; rises in the western part of the county; flows southerly 8 miles through Tres Palacios Bay into Matagorda Bay and Gulf of Mexico.

CUTHAND CREEK.—Red River County; rises about 8 miles south of Detroit in western part of county; flows southeasterly 28 miles into Sulphur River (tributary to Red River, which discharges into the Mississippi) about 13 miles south of Annona in southern part of county.

CYCLONE BRANCH.—Bell County; small stream flowing southerly into Camp Creek (tributary to Big Elm Creek, and thus through Little River to the Brazos) south of Oker in eastern part of county. Temple topographic map.

CYPRESS CREEK.—Angelina and Jasper counties; rises in southern part of Angelina County; flows southerly 8 miles into Neches River near Rockland in the northwestern part of Jasper County.

CYPRESS CREEK.—Blanco and Travis counties; rises south of Round Mountain in northern part of Blanco County; flows southeasterly 17 miles into Pedernales River (tributary to the Colorado) in the extreme western corner of Travis County just below Hamilton Pool post office. Blanco topographic map.

CYPRESS CREEK.—Cass County; rises near Queen City in northeastern part of county; flows northeasterly 11 miles into Sulphur River (tributary to Red River, which discharges into the Mississippi) about three-fourths mile southeast of Spencer Spur. Atlanta topographic map.

CYPRESS CREEK.—Harris County; rises in the northwestern part of county; flows easterly 35 miles to its junction with Spring Creek 3 miles northwest of Humble, then through San Jacinto River to Galveston Bay and thus to Gulf of Mexico. Satsuma, Loretta, Spring, and Weeden topographic maps.

CYPRESS CREEK.—Kendall County; southeast of Sisterdale in central part of county; flows into Guadalupe River.

CYPRESS CREEK.—Kerr and Kendall counties; rises in the northeastern part of Kerr County; flows southeasterly 9 miles through Kerr County, then 3 miles through Kendall County into Guadalupe River at Comfort in western part of Kendall County.

CYPRESS CREEK.—Travis County; small stream in the northwestern part of county; flows southwestward 6 miles to its junction with Colorado River 2 miles southwest of Anderson Mill. Austin topographic map.

DALBY CREEK.—Bowie County; rises about 4 miles north of the southwestern corner of county line; flows southerly 4 miles along county line into Sulphur River (tributary to Red River and thus to the Mississippi) near southwestern corner of county.

DALEY CREEK.—Edwards County; a small intermittent tributary to East Nueces River (thence to the Nueces) in eastern part of county, about one-half mile east of Vance; flows southeasterly 5 miles. Nueces topographic map.

DANIELS CREEK.—Caldwell County; rises southwest of McMalan in the northeastern part of county; flows into Plum Creek (tributary through San Marcos River to the Guadalupe). San Marcos topographic map.

DANIELS CREEK.—Potter County; rises 6 miles northeast of Wilderado near Potter-Oldham county line; flows northeasterly into Tecoyas Creek (tributary through the Canadian to Arkansas River and thus to the Mississippi) 3½ miles south of Field.

DARDEN CANYON CREEK.—Motley County; small stream rising in southeastern part of county and flowing into South Pease River (tributary to Middle Pease River, which discharges into Pease River and thus through Red River to the Mississippi).

DARK HOLLOW.—Eastland County; rises along the Texas Pacific Railway; flows southeasterly 4 miles into Leon River (tributary through Little River to the Brazos) 4 miles southeast of Eastland in central part of County. Eastland topographic map.

DARK VALLEY CREEK.—Palo Pinto County; rises near Jack-Palo Pinto county line; flows southerly 10 miles into Brazos River, 2 miles southeast of Folger in northern part of county. Palo Pinto topographic map.

DARRS CREEK.—Bell County; rises 4 miles south of Salado in southern part of county; flows easterly 17 miles into Little River (tributary to Brazos River) 7 miles southeast of Holland. Taylor topographic map.

DARST CREEK.—Guadalupe County; rises west of Belmont in the southeastern part of county; flows into Guadalupe River; intermittent. San Marcos topographic map.

DAVENPORT BRANCH.—Cooke County; about 4 miles northwest of Marysville in northern part of county; flows to North Fish Creek (tributary to Fish Creek and thus through Red River to the Mississippi); intermittent; very small. Gainesville topographic map.

DAVIS OR ROCK CREEK.—Fannin County; rises about 4 miles southeast of Bonham in central part of county; flows southeasterly 6 miles into North Sulphur River (tributary to Sulphur River and thus through Red River to the Mississippi).

DAVIS CREEK.—Newton County; rises about 4 miles south of Newton; flows southeasterly 12 miles into Sabine River.

DAVIS CREEK.—Stephens County; rises north of Yanceyville; flows northerly 5 miles into Brazos River 1 mile north of Young-Stephens county line. Breckenridge topographic map.

DAVIDSON CANYON CREEK.—Dickens County; rises in eastern part; flows southerly 6 miles into South Wichita River (tributary to Wichita River and thus through Red River to the Mississippi).

Davidson Creek.—Crosby County; rises 7 miles south of Crosbyton; flows southeasterly 11 miles into White River (which discharges into Brazos River through Salt Fork of the Brazos) in southeastern part of county.

Davidsons Creek.—Burleson County; rises near the northwest boundary line of county; flows southeasterly 35 miles into Yegua Creek (tributary to Brazos River) a mile southeast of Scofield; passes through the town of Caldwell. Gay Hill topographic map.

Dawney Creek.—Bowie County; small stream about 3 miles southwest of Texarkana Junction; flows into Harber Creek (tributary to Sulphur River, which discharges into the Mississippi through Red River). Texarkana topographic map.

Dawson Creek.—Brewster County; a stream 5 miles in length flowing southwesterly into Terlingua Creek (tributary to Rio Grande) 8 miles north of Terlingua Abaja. Terlingua and Chisos Mountains topographic maps.

Dead Horse Creek.—Eastland County; flows northeasterly 7 miles into South Fork of Leon River (tributary to Middle Fork of Leon and Leon rivers, thence through Little River to the Brazos) northwest of Carbon. Eastland topographic map.

Deadhorse Creek.—Hill County; small stream flowing southerly 7 miles to its junction with Aquilla Creek (tributary to Brazos River) in southern part of county 1 mile east of Aquilla. Waco topographic map.

Dead Mans Canyon.—Val Verde County; intermittent stream rising near center of county and flowing southwestward about 12 miles to its junction with Pecos River (tributary to Rio Grande) 2 miles north of Pecos High Bridge (Southern Pacific Lines).

Deadman Creek.—Jones, Shackelford, and Callahan counties; rises 12 miles southeast of Abilene; flows northerly 30 miles into Clear Fork of Brazos River (tributary to the Brazos) 3 miles north of Rising Sun in western part of Jones County near Jones-Shackelford county line. Abilene and Anson topographic maps.

Dead Mans Creek.—Knox County; small stream flowing into North Wichita River (tributary to Wichita River and thus through Red River to the Mississippi) northeast of Gilliland in northern part of county.

Deadmans Creek.—Val Verde County; rises in south central part of county; takes a southeasterly course 6 miles; joins Devils River (tributary to Rio Grande) 8 miles northwest of Comstock.

Deadmans Creek.—Young County; small stream flowing 1½ miles northeasterly into Brazos River southwest of Graham in southern part of county.

Dead Nigger Creek.—Garza County; rises in southwest part of county; flows northerly 3 miles into Double Mountain Fork of Brazos River, thence to the Brazos.

Decker Creek.—Travis County; a stream about 7 miles long flowing southeastward into Gilliland Creek (tributary to Colorado River) three-fourths mile east of Dunlap, in the eastern part of the county. Austin topographic map.

Deep or Asylum Creek.—Callahan and Shackelford counties; rises at Baird; flows northerly 55 miles into Hubbard Creek (tributary through Gonzales Creek to Clear Fork of Brazos River and thus to the Brazos) near McCatherine Mountain southeast of Albany. Albany topographic map.

Deep or Martin Creek.—Mason County; rises 3 miles north of Fly Gap in northeastern part of the county; flows southeastward 15 miles into Llano River (tributary to the Colorado) 1½ miles west of Castell. Mason and Llano topographic maps.

[illegible] ... tributary ... stream; rises ... part of McCulloch ... Colorado River; length, ...

[illegible] ... West Fork of Trinity ... part of the county. ... part of county; ... Navidad River ... stream rising about 2 ... tributary to ... part of ... overflowing empties into ... Red River and thus to the Mississippi ... square mile; ... northern part of ... Red River ... Fork ... Mississippi in ... southern ...

[illegible] ... northern part of the ... southeast of ...

[illegible] ... southwestern part of county; flows ... tributary to Red River ...

[illegible] ... miles southeast of ... southeasterly and ... Brazos River ... in central ...

[illegible] ... northeasterly ... Brazos River ... part of county.

Jack Creek, Tarrant County; rises approximately 3 miles west of Crowley; flows easterly 8 miles into Village Creek (tributary to West Fork of Trinity River, and thus to the Trinity) about 1 mile northeast of Oak Grove. Fort Worth topographic map.

Jack Creek, Medina County; a small intermittent tributary to Seco Creek (thence to the Nueces through Hondo and Frio rivers) in the southwestern part of county; flows southeastward 10 miles.

Jack Creek, Sabine County; small stream flowing into Sandy Creek in southwestern part of county, thence to Devils Ford, Bear Creek, and Ayish Bayou, and thus to Angelina and Neches rivers.

Jack Creek, San Saba, Mason, and Llano counties; a tributary to San Fernando Creek flowing through the northeastern part of Mason County, southwestern part of San Saba County, and northwestern part of Llano County into Llano River and thus to the Colorado; length, 9 miles. Brady, Mason, and Llano topographic maps.

Jack Creek, Scurry County; small stream flowing through the western part of the county into North Fork of Colorado River (tributary to the Colorado).

DELAWARE CREEK.—Culberson County, Tex., and Eddy County, N. Mex.; rises in eastern slope of Delaware Mountains in northwestern corner of Culberson County, Tex.; flows in northeasterly course, crosses New Mexico-Texas State line about 5 miles west of State line, and enters Pecos River (tributary to Rio Grande) 3 miles north of the State line; length, 50 miles. Gaging station near Angeles, 1914–1915.

DELAWARE CREEK.—Burnet County; small stream 4 miles in length flowing into Hamilton Creek (tributary to Colorado River) 3 miles south of Burnet in the south-central part of the county. Burnet topographic map.

DENTON CREEK.—Franklin County; rises about 2 miles south of Mount Vernon; flows northwesterly 6 miles into Big Creek (tributary to White-oak Bayou and thus through Sulphur and Red rivers to the Mississippi.

DENTON CREEK.—Gonzales County; rises northeast of Gonzales; flows southeasterly 10 miles into Peach Creek (tributary to Guadalupe River); intermittent. Flatonia topographic map.

DENTON CREEK.—Gonzales and Dewitt counties; rises in the southeastern part of Gonzales County; flows southeasterly 7 miles through Gonzales County, then 2 miles through Dewitt County into Guadalupe River near Hochheim. Flatonia topographic map.

DENTON CREEK, CLEAR FORK OF.—Gonzales County; south of Possumtrot in northeastern part of county; flows into Denton Creek and thus through Peach Creek to Guadalupe River. Flatonia topographic map.

DENTON CREEK.—Montague, Wise, Denton, Tarrant, and Dallas counties; rises about 3 miles northeast of Bowie in southwestern part of Montague County; flows southeasterly 43 miles into Elm Fork of Trinity River (tributary to Trinity River) about 2 miles west of Carrollton in the northwestern part of Dallas County. Fort Worth, Dallas, and Montague topographic maps.

DERAMADERA CREEK.—Duval County; small stream in southern part of county; flows southeasterly 5 miles; unites with Poquita Creek (Upper Los Olmos Creek) and flows into Gulf of Mexico through Baffins Bay.

DESERT CREEK.—Collin County; rises 1 mile south of Desert; flows southerly 5 miles into Pilot Grove Creek (tributary through Sister Grove Creek to East Fork of Trinity River and thus to the Trinity).

DEVILS FORD CREEK.—Sabine County; rises in southwestern part; flows southwesterly 9 miles into Bear Creek, and thus through Ayish Bayou to Angelina and Neches rivers.

DEVILS GULCH.—Montague County; small intermittent stream flowing into Farmers Creek (tributary to Red River, which discharges into the Mississippi) near Pearson in northern part of county. Montague topographic map.

DEVIL HOLLOW.—Caldwell County; rises in eastern part of county; flows into Sandy Fork of Peach Creek (tributary to Peach Creek and thus to Gualalupe River) northwest of Delhi. Flatonia topographic map.

DEVILS RIVER, EAST BRANCH.—Sutton County; joins Devils Rivers (tributary to Rio Grande) in the southwestern corner of county; approximate length, 20 miles.

DEW BERRY CREEK.—Wharton County; small tributary to West Bernard River (tributary to San Bernard River and thus to Gulf of Mexico) in northern part of county; flows southeasterly.

[illegible]

[illegible]

[illegible] Creek.—[illegible] County; [illegible] southwest of Savannah [illegible] Bear Creek [illegible] Galveston Bay and Gulf of Mexico. [illegible] topographic maps.

[illegible] Creek.—[illegible] County; small [illegible] in eastern part of county; flows southeasterly 3 miles to its junction with [illegible] River [illegible] thence to the Nueces through [illegible] rivers at [illegible]; intermittent. Uvalde topographic map.

Dixon Creek.—[illegible] County; an intermittent stream [illegible] miles long flowing northerly into Canadian River (tributary to Arkansas River and thus to the Mississippi) 2 miles southwest of [illegible] in southern part of county.

Dixon Lake.—(McFarland Lake); Bowie County; about [illegible] miles south of Maud in southern part of county; one of a series of lakes formed by an old channel of Sulphur River (tributary to Red and Mississippi rivers). New Boston topographic map.

Dockum Creek.—Dickens County; rises near Crosby-Dickens county line; flows southeasterly 18 miles into Duck Creek (tributary to Salt Fork of Brazos River and thus to the Brazos) 2 miles east of Spur in southern part of county.

Doctors Creek.—Delta County; rises about 7 miles northwest of Cooper; flows southeasterly 13 miles into South Sulphur River (tributary to Sulphur River and thus through Red River to the Mississippi) at the southern boundary of the county.

Dodd Branch.—Coryell County; rises near Lemon Gap 2½ miles east of King in central part of county; flows northeasterly 8 miles into Leon River (tributary to Little River and thus to the Brazos) at Gatesville. Gatesville topographic map.

Doe Creek.—Karnes County; small stream flowing through the southwestern part of the county into Escondido Creek (tributary to San Antonio River and thus to the Guadalupe).

Doe Run.—Washington County; an intermittent stream flowing southeasterly through eastern part of county into Brazos River; length, 10 miles. Navasota and Howth topographic maps.

Dog Creek.—Mason County; a small intermittent stream northeast of Mason in eastern part of county; flows into Willow Creek and thus through Llano River to the Colorado; length, 2 miles. Mason topographic map.

Dogwood Bayou.—San Augustine County; small stream flowing into Ayish Bayou (tributary to Angelina River and thus to the Neches) in central part of the county.

Dogwood Creek.—Austin and Washington counties; small stream flowing into East Fork of Mill Creek (tributary to Mill Creek, and thus to Brazos River) in southern part of Washington and northern part of Austin County near Wesley.

Dogwood Creek.—Fayette County; north of Colony in western part of county; an intermittent tributary through Live Oak and Buckner Creeks to Colorado River; length, 5 miles. Flatonia topographic map.

Dokegood Creek.—Garza County; rises 1 mile southwest of Buenas; flows northeasterly 5 miles into Gholson Creek (tributary through North Fork of Double Mountain Fork of Brazos River to Double Mountain Fork of Brazos River, thence to the Brazos) in northwestern part of county.

Donahoe Creek.—Milam, Bell, and Williamson counties; rises 7 miles south of Salado, near Bell-Williamson county line; flows easterly 22 miles into Little River (tributary to Brazos River) 5 miles southwest of Buckholts. Georgetown and Taylor topographic maps.

Donaho Creek.—Waller County; rises near Howth in northwestern part of county; flows southwesterly 9 miles into Brazos River 5 miles northeast of Chappel Hill.

Donalson Creek.—Lampasas County; rises in southern part of county; flows southeasterly 15 miles into Sulphur Creek (tributary to Lampasas River and thus through Little River to the Brazos) at Lampasas. Lampasas topographic map.

Double Creek.—Bowie County; rises about one-half mile south of Eylan; flows southwesterly 2½ miles into Harber Creek (tributary to Sulphur River and thus through Red River to the Mississippi) in southeastern part of county. Texarkana topographic map.

Double Mountain Fork of Brazos River, North Fork of.—Kent, Garza, Crosby, Lubbock, Hale, Lamb, and Bailey counties; rises in extreme northwestern corner of Bailey County; flows southeasterly 180 miles into Double Mountain Fork of Brazos River (tributary to the Brazos) 15 miles southwest of Clairemont in southwestern part of Kent County; principal tributary to Double Mountain Fork of Brazos River.

Double Mountain Fork of Brazos River.—Haskell, Stonewall, Fisher, Kent, Garza, and Lynn counties; rises 12 miles southeast of Tahoka in southern part of Lynn County; flows easterly 150 miles to its confluence with Salt

[illegible]

[illegible] Hansell county [illegible] North [illegible] (See [illegible])

[illegible] miles south of [illegible] northward [illegible] southern part [illegible]

[illegible] Bayou and thus to [illegible] length, 3 miles. [illegible]

[illegible] northwesterly [illegible] River, which discharges [illegible] topographic map.

[illegible] western [illegible] Green [illegible] through [illegible] miles northeast of [illegible] Sherwood [illegible]

[illegible] rises in [illegible] 20 miles into [illegible] River [illegible] Brazos.

[illegible] Nacogdoches; [illegible] Neches) [illegible] Railway [illegible]

[illegible] corner [illegible] tribu- [illegible] County.

[illegible] 7 miles [illegible] River about 2 miles west of the town [illegible] topographic map.

[illegible] of [illegible] flows [illegible] tributary to the [illegible]

Dry Branch—Stephens County: a small [illegible] stream flowing easterly 4 miles into [illegible] Creek [illegible] Creek, then through Clear Fork of Brazos River to the Brazos, in northern part of county, [illegible] Breckenridge topographic map.

Dry Branch—Stephens County: a [illegible] flowing stream 7 miles long [illegible] Creek [illegible] Creek to [illegible] Creek, thence through Clear Fork of Brazos River to the Brazos, 5 miles northwest of Breckenridge. Breckenridge topographic map.

Dry Branch—Shackelford County: a stream flowing northerly 7 miles into [illegible] Creek (tributary to [illegible] Creek and thus through Clear Fork of Brazos River to the Brazos) near Stephens-Shackelford county line east of Albany. Albany topographic map.

Dry Branch—Caldwell County: an intermittent stream rising southeast of [illegible] and flowing into Clear Fork of Plum Creek (tributary through Plum Creek to San Marcos River and thus to the Guadalupe). San Marcos topographic map.

DRY CREEK.—Armstrong County; rises in western part of county; flows southeasterly 10 miles into Prairie Dog Town Fork of Red River (tributary to Red River and thus to the Mississippi).

DRY CREEK.—Caldwell County; rises near Mendoza in northern part of county; flows southerly 9 miles into Plum Creek (tributary through San Marcos River to the Guadalupe) 2 miles east of Lockhart. Austin and and San Marcos topographic maps.

DRY CREEK.—Coke and Tom Green counties; small stream rising in southern part of Coke County and flowing southward 20 miles into North Concho River (tributary to Concho River and thus to the Colorado) 10 miles northwest of San Angelo in northern part of Tom Green County. Hayrick topographic map.

DRY CREEK.—Coke County; rises east of Hayrick in northeastern part of county; flows 4 miles into Kickapoo Creek and thus to the Colorado; intermittent. Hayrick topographic map.

DRY CREEK.—Concho County; an intermittent stream west of Paint Rock in the northwestern part of county; flows 16 miles into Concho River (tributary to the Colorado). Hayrick and San Angelo topographic maps.

DRY CREEK.—Travis and Bastrop counties; in eastern part of Travis and western part of Bastrop County; small tributary through Wilbarger Creek to Colorado River; length, 5 miles. Bastrop topographic map.

DRY CREEK.—Travis and Bastrop Counties; rises near Creedmoor in the southwestern part of Travis County; flows northeastward through Bastrop County into Colorado River; length, 18 miles. Austin and Bastrop topographic maps.

DRY CREEK.—Caldwell County; rises 2 miles south of Miers; flows southwesterly 9 miles into Plum Creek (tributary through San Marcos River to the Guadalupe) 2 miles east of Cibolo in northeastern part of county. San Marcos topographic map.

DRY CREEK.—Edwards County; a small intermittent tributary to East Nueces River, and thus to Nueces River in the southeastern part of the county about 1½ miles north of Barksdale; length, 5 miles. Nueces topographic map.

DRY CREEK.—Fisher County; an intermittent stream flowing northeasterly 7 miles into Clear Fork of Brazos River (which discharges into the Brazos) 1½ miles southeast of Newman. Roby topographic map.

DRY CREEK.—Hopkins and Wood Counties; rises about 2 miles southeast of Carrolls Prairie in Hopkins County; flows southerly 20 miles into Lake Fork of Sabine River (tributary to Sabine River) about 2 miles south of Quitman in Wood County.

DRY CREEK.—Irion County; small intermittent stream in northern part of the county flowing southeasterly about 13 miles into Middle Concho River (tributary to South Concho River and thus through the Concho to Colorado River), 4½ miles southwest of Arden. Sherwood topographic map.

DRY CREEK.—Llano County; an intermittent stream 4 miles long flowing into Llano River and thus to the Colorado west of Kingsland in the southeastern part of the county. Llano and Burnet topographic maps.

DRY CREEK.—McLennan County; a small stream flowing easterly 6 miles into Bull Hide Creek (tributary to Brazos River) south of Rosenthal in southern part of county. Temple topographic map.

DRY CREEK.—McLennan and Hill counties; rises at Tyson in southern part of Hill County; flows southward 8 miles into Aquilla Creek (tributary to Brazos River) 1 mile east of Gholson; intermittent. Waco topographic map.

DRY CREEK.—Uvalde County; small intermittent stream rising in the northwestern part of county southwest of Montell and flowing ino East Nueces River. Nueces topographic map.

DRY CREEK.—Schleicher and Tom Green counties; rises in northern part of Schleicher County; flows northwesterly 11 miles into South Concho River, 5 miles south of Christoval; intermittent. San Angelo topographic map.

DRY CREEK.—Parker County; rises 3 miles northwest of Peister in northwestern part of county; flows southwesterly 14 miles into Rock Creek (tributary to Brazos River) 3½ miles northwest of Millsap. Weatherford and Palo Pinto topographic maps.

DRY CREEK.—Young County; rises 6 miles east of Graham; flows southwesterly 8 miles into Salt Creek (tributary to Brazos River) near mouth of Salt Creek in southern part of county.

DRY CREEK.—Van Zandt and Smith counties; rises in eastern part of Van Zandt County; flows northeasterly 12 miles into Sabine River (and thus to the Gulf of Mexico) in the extreme northwestern part of Smith County near Silver Lake.

DRY DRAW.—Edwards County; an intermittent tributary to South Llano River (thence to the Colorado through Llano River) northwest of Harris in northern part of county; length, 23 miles. Rock Springs topographic map.

DRY FORK OF GRACES CREEK.—Gregg County; small stream flowing into Graces Creek (tributary to Sabine River) about 1½ miles west of Longview.

DRY GULLY.—Harris County; rises in northwestern part of county 1½ miles northeast of Louetta; flows southeasterly 3 miles into Cypress Creek; intermittent. Louetta topographic map.

DRY RUN.—Gonzales County; a small intermittent stream in northern part of county; flows into Sandy Fork of Peach Creek, thence to Peach Creek (tributary to Guadalupe River). Flatonia topographic map.

DRY VALLEY.—Montague County; rises near New Hope School; flows southerly 7 miles; joins Mallard Creek (tributary to Denton Creek, then through Elm Fork of Trinity River to the Trinity) 1 mile southeast of Dry Valley School; intermittent. Montague topographic map.

DRY BLANKET CREEK.—Brown and Comanche counties; a stream 11 miles long connecting with Blanket Creek (tributary through Pecan Bayou to the Colorado) 2 miles northeast of Zephyr in southeastern part of Brown County. Brownwood topographic map.

DRY BRUSHY CREEK.—Williamson County; rises south of Leander in southwestern part of county; flows southeasterly into Brushy Creek (tributary to San Gabriel River and thus through Little River to the Brazos) 4 miles northwest of Round Rock. Georgetown topographic map.

DRY BRUSHY CREEK.—Williamson County; rises near corner of Travis, Bastrop, and Williamson counties; flows northeasterly 11 miles into Boggy Creek (tributary to San Gabriel River through Brushy Creek, and thus through Little River to the Brazos) southeast of Taylor. Austin and Georgetown topographic maps.

DRY CALIFORNIA CREEK.—Jones and Fisher counties; an intermittent stream rising 2 miles southeast of Taopi in eastern part of Fisher County and flowing northeastward 13 miles to a point 7 miles north of Neinda in northwestern part of Jones County where it enters California Creek and thus through Clear Fork of Brazos River to the Brazos. Roby topographic map.

DRY COMAL CREEK.—Comal County; headwater stream uniting with Comal River (tributary to Guadalupe River) in New Braunfels in southeastern part of county; intermittent.

DRY CYPRESS CREEK.—Wood, Franklin, and Camp counties; rises in southeastern part of Wood County; flows northeasterly 13 miles into Big Cypress Creek (tributary to Caddo Lake, which discharges into the Mississippi through Red River) at the northwestern boundary of Camp County.

DRY DEVILS RIVER.—Val Verde County; rises in eastern part of county; flows southwesterly about 10 miles into Devils River (tributary to Rio Grande); intermittent.

DRY DUCK CREEK.—Kent County; a southeasterly flowing stream joining Salt Fork of Brazos River (tributary to the Brazos) 7 miles southwest of Jayton; length, 7 miles.

DRY ELM CREEK.—Cooke County; rises about 4 miles southwest of Marysville in western part of county; flows southeasterly 12 miles into Elm Fork of Trinity River (tributary to the Trinity) about 2 miles southwest of Lindsay. Gainesville topographic map.

DRY FORK OF ARMSTRONG CREEK.—Erath County; a small intermittent stream flowing southward 4 miles into Armstrong Creek (tributary through Leon River to Little River and thus to the Brazos) west of Lingleville in western part of county. Stephenville topographic map.

DRY FORK.—Gonzales County; small intermittent stream flowing into Smith Creek (tributary to San Marcos River) 3 miles northwest of Gonzales. Flatonia topographic map.

DRY FRIO RIVER.—Uvalde County; intermittent stream; rises near Uvalde-Real county line; flows southeastward 25 miles to its junction with Frio River (tributary to Nueces River) one mile southwest of Knippa. Uvalde topographic map.

DRY HOLLOW CREEK.—Gillespie County; rises in eastern part of county; flows 3 miles parallel to eastern county line into North Grape Creek and thus to the Pedernales and Colorado rivers. Fredericksburg topographic map.

DRY LIPAN CREEK.—Tom Green County; an intermittent stream; rises east of San Angelo in northeastern part of county; flows into Lipan Creek (tributary to Concho River and thus to the Colorado); length, 20 miles. San Angelo topographic map.

DRY SYCAMORE CREEK.—Edwards and Kinney counties; small intermittent tributary to Sycamore Creek (thence to Nueces River through Silver Lake and West Nueces River) in southern part of Edwards and northeastern part of Kinney County; flows southerly 12 miles. Nueces topographic map.

DUBBS LAKE.—Donley County; about 2½ miles northwest of Clarendon; outlet, when overflowing, Kelley Creek (tributary to Salt Fork of Red River, and thus through Prairie Dog Town Fork of the Red to Red River, thence to the Mississippi); area, about one-half square mile.

DUCK CREEK.—Clay County; a stream 9½ miles long flowing southerly to a point in the western part of county, where it enters little Wichita River (tributary to Red River, which discharges into the Mississippi).

DUCK CREEK.—Cooke and Denton counties; rises about 5 miles west of Valley View in Cooke County; flows southerly 14 miles into Clear Creek (tributary to Elm Fork of Trinity River, thence to the Trinity) about 1½ miles south of Huling in northern part of Denton County. Gainesville topographic map.

DUCK CREEK.—Concho County; rises southeast of Paint Rock in northeastern part of county; flows 20 miles into Concho River (tributary to the Colorado). Ballinger and Eden topographic maps.

DUCK CREEK.—Dallas and Kaufman counties; rises about 2 miles northeast of Richardson in northern part of Dallas County; flows southeasterly 18 miles into East Fork of Trinity River approximately 3 miles above the Texas Pacific Railway crossing in northwestern corner of Kaufman County. Dallas and Barnes Bridge topographic maps.

DUCK CREEK.—Kent and Dickens counties; rises 6 miles northwest of Dickens in southwestern part of Dickens County; flows southeasterly 40 miles into Salt Fork of Brazos River (tributary to the Brazos) 6 miles northeast of Clairemont in central part of Kent County.

DUCK CREEK.—Grayson County; rises in northern part of the town of Denison; flows northerly 3 miles into Red River; intermittent. Denison topographic map.

DUCK CREEK.—Limestone and Robertson counties; rises near Kosse in southern part of Limestone County; flows southeasterly 25 miles into Navasota River (tributary to Brazos River) southeast of lake in eastern part of Robertson County.

DUCK CREEK.—Smith County; flows northeasterly 9 miles into Sabine River about 2 miles east of point where International Great Northern Railroad crosses Sabine River in northwestern part of county.

DUCK CREEK.—Van Zandt and Hunt counties; rises in northwest corner of Van Zandt County; flows northerly 3 miles into South Fork of Sabine River (thence to Sabine River) in southeastern part of Hunt County.

DUDLEY CREEK.—Roberts County; rises 14 miles west of Miami; flows northerly 20 miles into Canadian River (tributary to Arkansas River and thus to the Mississippi) 26 miles northwest of Miami in northern part of county.

DUDLEYS CREEK.—Haskell County; a stream flowing southeastward 7 miles into Paint Creek (which discharges into California Creek and thus through Clear Fork of Brazos River to the Brazos) in southern part of county.

DUFFAU CREEK.—Bosque and Erath counties; rises about 3 miles northwest of Johnsville; flows southeasterly 20 miles into Bosque River (tributary to Brazos River) a mile southwest of Iredell in western part of Bosque County. Stephenville, Granbury, and Meridian topographic maps.

DUFFORD CREEK.—Harrison County; in southwestern part of county; flows southeasterly 11 miles into Sabine River.

DUGAN CREEK.—Wilbarger County; rises in northern part; flows northeasterly 7 miles into Pease River (tributary through Red River to the Mississippi) about 1½ miles northeast of Kingola.

DUGOUT DRAW.—Brewster County; rises 5 miles northwest of Boquillas; joins Tornillo Creek (tributary to Rio Grande) 1 mile north of Boquillas. Chisos Mountains topographic map.

DUNCAN CREEK.—Comanche County; rises 3 miles northwest of the town of Comanche is central part of county; flows northeasterly 10 miles into Copperas Creek (which discharges into the Leon and thus through Little River to the Brazos) 7 miles northeast of Comanche. Brownwood topographic map.

DUNCAN CREEK.—Fannin County; rises in northeastern part of county; flows southeastward 3½ miles into Bois d'Arc Creek (tributary to Red River and thus to the Mississippi).

DUNN CREEK.—Hunt County; small stream flowing into Cowleach Fork of Sabine River (thence to Sabine River through Caddo Fork of Sabine River) in southeastern part of county.

DURAZNO BAYOU.—Nacogdoches County; flows southwesterly 5 miles into Angelina River (tributary to Neches River) in the southeastern part of county.

DURAZNO CREEK.—Angelina County; rises in northern part of county; flows northeasterly 8 miles into Angelina River (tributary to the Neches).

DUTCH BRANCH.—Tarrant County; small stream flowing into Clear Fork of Trinity River (tributary to West Fork of the Trinity and thus to Trinity River) south of Ben Brook in southwestern part of county. Weatherford and Fort Worth topographic maps.

DUTCHMAN BRANCH.—King County; rises in eastern part; flows northerly 4 miles into South Wichita River, thence to Wichita River and thus through Red River to the Mississippi.

DUTCHMAN CREEK.—Motley County; rises about 1 mile east of Lyman in southwestern part of county; flows southeastward 6 miles into Walnut Creek (tributary to South Pease River and thus through Middle Pease to Pease River, thence through Red River to the Mississippi).

DUTYS CREEK.—Fayette County; tributary to Colorado River in southeastern part of county; length, 7 miles.

DYE CREEK.—Montague County; rises near Blue Mound; flows southeasterly 7 miles into Clear Creek (tributary to Elm Fork of Trinity River and thus to the Trinity) one-half mile west of Gladys in southeastern part of county. Montague topographic map.

EAGLE CREEK.—Coryell County; a small intermittent stream in northern part of county flowing southeasterly 7 miles into Leon River (tributary through Little River to the Brazos) 5 miles south of Jonesborough. Meridian topographic Map.

EAGLE CREEK.—Nolan County; rises west of Blackwell in southern part of county; flows 12 miles into Oak Creek and thus to the Colorado. Sweetwater topographic map.

EAGLE CREEK.—Palo Pinto County; rises 4 miles east of Metcalf Gap in central part of county; flows northerly 11 miles into Brazos River 1½ miles west of Kyle Mountain and 4½ miles northwest of Palo Pinto. Palo Pinto topographic Map.

EAGLE CREEK.—Wilson County; rises north of Saspamco in Western part of county; empties into Calaveras Creek (tributary to San Antonio River and thus to the Guadalupe).

EAGLE HOLLOW.—Donley County; rises in east central part; takes northeastward course 3½ miles into Salt Fork of Red River (tributary through Prairie Dog Town Fork of the Red to Red River and thus to the Mississippi).

EAST BRANCH.—Fayette County; small intermittent tributary to Cedar Creek thence to Colorado River in northwestern part of county. Flatonia topographic map.

EAST CREEK.—Walker County; small stream in southern part of county; flows southwesterly 10 miles into West San Jacinto River, thence to San Jacinto River, Galveston Bay and Gulf of Mexico.

EAST CREEK.—Franklin County; small stream in northwestern part of county; flows southeasterly 5 miles into Whiteoak Bayou (tributary to Sulphur River and thus through Red River to the Mississippi).

EAST ALAMOSA CREEK.—Oldham County; rises 7 miles north of Vega; flows northerly 13 miles to its union with Middle Alamosa Creek (tributary through the Canadian to Arkansas River and thus to the Mississippi) 4 miles west of Cheyenne, in northeastern part of county; intermittent.

EAST BAY BAYOU.—Chambers County; tidal stream in southeastern part of county formed by union of Elm and Mud bayous; flows southwesterly into East Galveston Bay and thence to Gulf of Mexico.

East Belknap Creek.—Montague County; rises about 6 miles east of Stoneburg in western part of county; flows northwesterly 11 miles into Belknap Creek (tributary to Red River and thus to the Mississippi) 3 miles southwest of Belcherville. Montague topographic map.

East Bitter Creek.—Donley and Hall counties; rises in southern part of Donley County; flows southwesterly 6½ miles into Bitter Creek (tributary to Mulberry Creek, thence through Prarie Dog Town Fork of Red River to the Red and thus to Mississippi) in northwestern part of Hall County.

East Bosque River.—Bosque and Erath counties; rises near Flag Creek Gap in southeastern corner of Erath County; flows southeasterly 15 miles into Bosque River (tributary to the Brazos) about 2 miles south of Pilot Knob in the western part of Bosque County. Meridian and Granbury topographic maps.

East Buffalo Creek.—Johnson County; rises 2½ miles southeast of Joshua; flows southerly 9 miles to a point 1 mile south of Cleburne, where it unites with West Buffalo Creek and passes to the Brazos through Buffalo Creek and Nolands River. Cleburne topographic map.

East Buffalo Creek.—Lipscomb County; rises 11 miles southwest of Lipscomb; flows northerly 8 miles into Wolf Creek (tributary to North Fork of Canadian River and thus through the Canadian and Arkansas to Mississippi River) 6 miles west of Lipscomb in western part of county.

East Brushy Creek.—Delta County; rises 5 miles east of Cooper; flows southeasterly 5 miles to its junction with West Brushy Creek to form Brushy Creek (tributary to South Sulphur River and thus through Sulphur River and the Red to Mississippi River).

East China Creek.—Fisher County; an intermittent stream in southeastern part of county; flows northeasterly 5 miles into China Creek (tributary to Clear Fork of Brazos River and thus to the Brazos) west of Newman. Roby topographic map.

East Copperas Creek.—Kimble County; a small stream 4 miles in length in the northwestern part of county flowing through Copperas Creek into North Llano River and thus through the Llano to Colorado River. Fort McKavett topographic map.

East Cottonwood Creek.—Fisher County; an intermittent stream flowing northerly 9 miles into Cottonwood Creek (tributary through Clear Fork of Brazos River to the Brazos) southwest of Roby. Roby topographic map.

East Fork of Trinity River (Bois d'Arc River).—Grayson, Collin, Rockwall, Dallas, and Kaufman counties; rises about 2 miles west of Howe in Grayson County; flows southerly 78 miles into Trinity River about 2 miles above the crossing of the Texas Midland Railway in southwestern part of Kaufman County. Dallas, Barnes Bridge, and Rockwall topographic maps.

East Grindstone Creek.—Parker County; rises 2 miles southwest of Lambert in western part of county; flows southerly 8 miles into Grindstone Creek (tributary to Brazos River) 2 miles southwest of Brock. Weatherford topographic map.

East Jones Creek.—Montague County; a stream flowing into Jones Creek (tributary to Big Sandy Creek, thence through West Fork of Trinity River to the Trinity) south of the town of Bowie in southwestern part of county; intermittent. Montague topographic map.

East Kickapoo Creek.—Concho County; a stream flowing to the south of Paint Rock in the western part of county to its junction with Kickapoo Creek (tributary to Concho River and thus to the Colorado); length, 13 miles. Eden topographic map.

East Kickapoo Creek.—Runnels County; rises to the northwest of Maverick in western part of Runnels County; flows into Kickapoo Creek (tributary to Colorado River); length, 7 miles. Hayrick topographic map.

East Little Postoak Creek.—Archer County; rises in eastern part of county; flows northerly 6½ miles to its junction with West Little Postoak Creek to form Little Postoak Creek (tributary to Postoak Creek and thus through Little Wichita and Red Rivers to the Mississippi), about 11 miles northeast of Archer City.

East Mountain Creek.—Cooke County; an intermittent stream 5 miles long flowing northerly into Mountain Creek (tributary to Red River and thus to the Mississippi) in northwestern part of county. Gainesville topographic map.

East Navidad River.—Fayette County; rises near Black Jack Springs near central part of county; flows southerly 13 miles into Navidad River (tributary to Lavaca River, and thence to Gulf of Mexico through Matagorda Bay) 3 miles southeast of Schulenburg.

East Poor Hollow.—Schleicher County; an intermittent stream 11 miles long flowing through the eastern part of county, northwest of Fort McKavett, to its junction with Poor Hollow and thus through Poor Valley and North Valley to the San Saba (tributary to Colorado River). Fort McKavett and San Angelo topographic maps.

East Prairie Branch.—Montague County; joins Prairie Branch (tributary through Big Sandy Creek to West Fork of Trinity River, and thus to the Trinity) west of Bowie, in the southwestern part of county; intermittent. Montague topographic map.

East Salt Creek.—Collingsworth and Childress counties; rises about 1 mile north of south boundary of Collingsworth County; flows southeastward 11 miles into Salt Creek (tributary to Prairie Dog Town Fork of Red River and thus through Red River to the Mississippi), in northern part of Childress County.

East Sanches Creek.—Parker County; rises 1 mile south of Weatherford, in central part of county; flows southerly 7 miles into Sanches Creek (tributary to Brazos River) a mile north of Balch. Weatherford topographic map.

East San Jacinto River.—Walker, San Jacinto, Liberty, Montgomery, and Harris counties; rises in southwestern part of Walker County; flows southeasterly, southerly, and southwesterly 3 miles through Walker County, 22 miles through San Jacinto, 13 miles through Liberty County, 8 miles through Montgomery County, then 4 miles through Harris County into San Jacinto River (tributary to Galveston Bay and Gulf of Mexico).

East Shawnee Creek.—Rusk County; rises in southeastern part of county; flows southwesterly, then westerly into Angelina River (tributary to Neches River), in the southwestern corner of county; length, 22 miles.

Ecleto Creek.—Guadalupe, Wilson, and Karnes counties; rises in southern part of Guadalupe County; flows southeasterly 8 miles through Guadalupe County, 18 miles through Wilson County, then 25 miles through Karnes County, where it joins San Antonio River (tributary to the Guadalupe) near the town of Runge, in eastern part of Karnes County.

Edd Creek.—Bowie County; rises 3 miles southeast of Dalby Springs; flows easterly 4 miles into Bassett Creek (tributary to Sulphur River and thus through Red River to the Mississippi) about 1½ miles northwest of Bassett, in southwestern part of county.

Ednas Creek.—Baylor County; an eastward-flowing stream 5 miles long joining Brazos River 5 miles west of Seymour, in western part of county.

EDWARDS BRANCH.—Stephens County; a small stream flowing southeasterly 4 miles into Hubbard Creek (tributary to Gonzales Creek, thence through Clear Fork of Brazos River to the Brazos), in northwestern part of county. Albany topographic map.

EDWARDS CREEK.—Polk and Liberty counties; joins Menard Creek (tributary to Trinity River) in northern part of Liberty County near Polk-Liberty county line.

EIGHTMILE CREEK.—Harrison County; rises about 3 miles northeast of Marshall; flows southerly 19 miles into Sabine River at the intersection of the Harrison-Panola county line.

ELBA CREEK.—Grayson County; rises about 6 miles west of Sherman, in central part of county; flows northwesterly 7 miles into Beaver Creek (tributary to Mineral Creek, thence to Red River and thus to the Mississippi) about 3 miles east of Sadler. Denison topographic map.

ELBOW LAKE.—Bowie County; about 5½ miles southeast of Maud in southern part of county; outlet, Sulphur River (tributary to Red River and thus to the Mississippi); formerly a channel of Sulphur River. New Boston topographic map.

ELIZABETH CREEK.—Tarrant and Denton counties; rises near Blue Mound in northwestern part of Tarrant County; flows northeasterly 10 miles into Denton Creek (tributary to Elm Fork of Trinity River and thus to the Trinity) about 2 miles north of Roanoke in southwestern part of Denton County.

ELKHART CREEK.—Anderson and Houston counties; rises near the Houston-Anderson County line in Anderson County; flows southwesterly 16 miles into Trinity River in northwestern part of Houston County.

ELLIOTT CANYON CREEK.—Motley County; small stream in southeastern part of county flowing into South Pease River (tributary through Middle Pease River and thus through Red River to the Mississippi).

ELLIOTT CREEK.—Lampasas County; a stream 10 miles long in western part of the county; flows into Colorado River. San Saba topographic map.

ELLIOTT CREEK.—Bowie County; rises about 2 miles south of Hooks; flows southeasterly 15 miles into Sulphur River (tributary to Red River and thus to the Mississippi) about 5 miles west of Draper in southeastern part of county. New Boston and Texarkana topographic maps.

ELLIOTT CREEK.—Cass County; rises about 3 miles northeast of Marietta in northwestern part of county; flows northwesterly 3½ miles into Mill Creek (tributary to Sulphur River and thus through Red River to the Mississippi). Daingerfield topographic map.

ELLISON BRANCH.—Eastland County; rises 2 miles northeast of Gorman; flows northeasterly 4 miles into Leon River (tributary to the Brazos through Little River). Eastland topographic map.

ELM BAYOU.—Chambers County; a tidal stream rising in southeastern part of county; flows southerly 9 miles to its junction with Mud Bayou (tributary to East Bay Bayou and thus to East Galveston Bay thence to Gulf of Mexico).

ELM BRANCH.—Palo Pinto County; rises near Erath-Palo Pinto County line; flows northeasterly 4 miles into Buck Creek (tributary to Palo Pinto Creek and thus to Brazos River) 2 miles northeast of Jacobs Wells. Palo Pinto topographic map.

ELM OR CHIQUIHUITILLA CREEK.—Atascosa County; small tributary of Atascosa River (thence to Frio and Nueces rivers) in the southeastern part of the county; flows southwesterly; length, 12 miles.

Elm Creek.—Atascosa County; a small tributary to Sesteadero Creek (thence to Nueces River through Atascosa and Frio rivers) in the northwestern part of county; flows northeastward 3 miles.

Elm Creek.—Bastrop County; small intermittent stream in western part of county; flows northwesterly 7 miles to its junction with Walnut Creek (tributary to Colorado River) 2 miles northwest of Old Redrock. Flatonia topographic map.

Elm Creek.—Bee County; small tributary to Aransas River (thence to Copano Bay and Gulf of Mexico) in the southwestern part of county; flows easterly 7 miles.

Elm Creek.—Bexar County; flows easterly 15 miles into Medina River (tributary to San Antonio River and thus to the Guadalupe) in southwestern part of county. San Antonio topographic map.

Elm Creek.—Brown County; a small stream flowing south of Byrds store in northwestern part of county; tributary through Pecan Bayou to Colorado River; length, 7 miles. Coleman topographic map.

Elm Creek.—Brown County; small stream northwest of Clio in the northern part of the county; flows northwestward 6 miles into Hog Creek (tributary to Pecan Bayou and thus to the Colorado). Brownwood topographic map.

Elm Creek.—Caldwell and Hays counties; rises 3 miles south of Creedmoor in southeastern corner of Hays County; flows 4 miles through Hays County, then 7 miles through Caldwell County to its junction with Plum Creek (tributary through San Marcos River to the Guadalupe) 3 miles north of Lockhart.

Elm Creek.—Collin County; rises 2 miles north of Farmersville; flows southwesterly 12 miles into Sister Grove Creek (which discharges into Trinity River through the East Fork of the Trinity) about 2 miles north of Clear Lake.

Elm Creek.—Coleman County; a stream flowing to the southwest of Valera, in the southwestern part of the county, into Colorado River; length, 26 miles Ballinger topographic map.

Elm Creek.—Duval and McMullen counties; rises in northern part of Duval County; flows northwestward 10 miles through Duval County, then 16 miles through McMullen County into Nueces River.

Elm Creek.—Eastland County; rises 1½ miles northeast of Rising Star in southern part of county; flows northeasterly 10 miles into Sabanna River (tributary through Leon and Little rivers to the Brazos) 4 miles southwest of Jewell. Eastland topographic map.

Elm Creek.—Ellis County; small stream flowing into South Fork of Pecan Creek (tributary to Pecan and Richland creeks, thence to Trinity River) in the southwestern part of the county.

Elm Creek.—Fayette County; southwest of Cistern in southwestern part of county; intermittent tributary to Peach Creek (thence to Guadalupe River). Flatonia topographic map.

Elm Creek.—Hopkins and Rains counties; rises about 4 miles southeast of Blackjack Grove in Hopkins County; flows southeasterly 14 miles into Lake Fork of Sabine River (tributary to the Sabine) about 4 miles northeast of Emory in Rains County.

Elm Creek.—Jones, Nolan, and Taylor counties; rises 1 mile south of Dora in eastern part of Nolan County; flows northeasterly 60 miles, passes near Buffalo Gap and Abilene, into Clear Fork of Brazos River (tributary to the Brazos) 1½ miles north of Phantom Hill in southeastern part of Jones County. Sweetwater, Abilene, and Anson topographic maps.

ELM CREEK.—Kinney County; rises 10 miles northeast of Brackett; flows southwesterly 32 miles into Rio Grande and thus to Gulf of Mexico; intermittent. Brackett topographic map.

ELM CREEK.—Kinney, Maverick, Zavalla, and Dimmit counties; rises in the central part of Kinney County about 6 miles northeast of Brackettville at an approximate elevation of 1,500 feet above sea level; flows southeasterly 24 miles through Kinney County, 21 miles through northeastern part of Maverick County, 24 miles through the southwestern part of Zavalla County, then 11 miles through the northwestern part of Dimmit County into Nueces River in the northwestern part of Dimmit County, about 10 miles north of Carrizo Springs. Brackett topographic map.

ELM CREEK.—Lee County; rises near Hills on Houston & Texas Central Railroad; flows northeastward 8 miles into Third Yegua Creek (tributary through Second Yegua Creek to Yegua Creek and thus to the Brazos) near Lincoln on San Antonio & Aransas Pass Railway in central part of county.

ELM CREEK.—Mason and Llano counties; an intermittent stream flowing along the boundary of Mason and Llano counties 11 miles; joins the Llano (tributary to Colorado River) 2 miles east of Castell. Mason and Llano topographic maps.

ELM CREEK.—McCulloch County; a stream 14 miles long rising southeast of Pueblo in the northern part of the county and flowing into Colorado River. Brady topographic map.

ELM CREEK.—McCulloch County; rises in northwestern part of county 6 miles northeast of Salt Gap; flows northeasterly 9 miles into Colorado River; intermittent. Eden and Brady topographic maps.

ELM CREEK.—McLennan County; small intermittent stream in northern part of county flowing southerly 4 miles into Aquilla Creek (tributary to Brazos River) southwest of Ross. Waco topographic map.

ELM CREEK.—McMullen County; a small tributary to Willow Creek (which discharges into Nueces River through Frio River) in the northwestern part of county; length, 3 miles.

ELM CREEK.—Menard County; a small stream southeast of Menard in the eastern part of county; flows 7 miles into San Saba River and thus to the Colorado.

ELM CREEK.—Robertson County; a stream 1½ miles long flowing northwesterly into Peach Creek (tributary through Campbells Creek to Little Brazos River and thus to the Brazos) south of Benchley.

ELM CREEK.—Taylor and Runnels counties; rises 1 mile south of Guion in the southern part of Taylor County; flows southerly 4 miles through Taylor County, then 28 miles through Runnels County to its junction with Colorado River one-half mile below Ballinger in the southern part of Runnels County. Abilene and Ballinger topographic maps.

ELM CREEK.—Travis County; small intermittent stream rising 2½ miles above Hornsby; flows southeasterly 7 miles into Gilleland Creek (tributary to Colorado River) about a mile southeast of Dunlap. Austin topographic map.

ELM CREEK.—Travis County; rises near Elgin in eastern part of county; flows southwestward 7 miles into Wilbarger Creek and thus to Colorado River. Bastrop topographic map.

ELM CREEK.—Young and Throckmorton counties; rises 8 miles west of Williamsburg in northern part of Throckmorton County; flows eastward 34 miles into Brazos River 3 miles east of Proffitt in western part of Young County.

ELM CREEK.—Zavalla County; small intermittent tributary to Liveoak Creek (thence to Nueces River through Yo-lo-digo Creek, Leona and Frio rivers) in northeastern part of the county. Uvalde topographic map.

ELM FORK OF TRINITY RIVER (ELM OR BIG ELM CREEK).—Montague, Cooke, Denton, and Dallas counties; rises about 1 mile northwest of Saint Jo in eastern part of Montague County; flows southeasterly 85 miles to its junction with West Fork of Trinity River forming Trinity River about 5 miles northwest of Dallas. Montague and Dallas topographic maps.

ELM FORK OF OLIVERS CREEK.—Denton County; a short stream flowing into Olivers Creek (tributary to Denton Creek and thus through Elm Fork of the Trinity to Trinity River) in the southwestern part of the county.

ELM FORK OF RED RIVER.—Wheeler and Collingsworth counties, Tex., and Beckham, Harmon, and Greer counties, Okla., rises about 4 miles northwest of Ramsdell in southwestern part of Wheeler County; flows southeasterly 30 miles to its intersection with the Texas-Oklahoma boundary line about 5 miles east of Aberdeen in eastern part of Collingsworth County, then southeasterly to its junction with North Fork of Red River (tributary to Red River and thus to the Mississippi) in southeastern part of Greer County, Okla.

ELM FORK OF TEHUACANA CREEK.—Limestone and Freestone counties; rises about 3 miles northeast of Mexia in Limestone County; flows northeasterly 4 miles into Tehuacana Creek (tributary to Trinity River) in Freestone County about 3 miles south of Tehuacana.

ELM GROVE CREEK.—Grimes County; rises in southern part of county; flows southerly from West Academy into Beasom Creek (tributary to Brazos River) 2 miles southeast of Linn Grove. Navasota topographic map.

ELM MOTT BRANCH.—Hill County; a short stream in the extreme western part of the county; flows southerly 2½ miles into Brazos River opposite Bee Mountain. Granbury topographic map.

ELMIR BRANCH.—Erath County; a southerly flowing stream 4 miles long joining North Paluxy Creek (tributary to Paluxy Creek and thus to Brazos River) 2 miles west of Bluff Dale in northern part of county. Stephenville topographic map.

EL MORO CREEK.—Dimmit County; intermittent stream in central part of county; flows northeastward 22 miles to its junction with Nueces River 4 miles southeast of Asherton.

EL SARCO RIVER.—Goliad and Refugio counties; rises in southern part of Goliad County; flows southeastward and southwestward 10 miles to its junction with Blanco Creek, then southeastward 3 miles along the boundary of Goliad and Bee counties, thence southeastward 9 miles to its junction with Medio Creek, below which the stream is known as Rio de la Mission (tributary to Gulf of Mexico through Copano Bay).

EMBERSON LAKE.—Lamar County; near Razor in northern part of county; outlet, Red River (tributary to the Mississippi); formerly an old channel of Red River.

ENDORA LAKE.—Dallam County; 5 miles south of Oklahoma-Texas boundary line in northern part of county; outlet, Rabbit Ear Creek.

ENNIS, PARADISE, OR POOL CREEK.—Wilbarger County; rises in southwestern part of county; flows northeasterly 22 miles into Pease River (tributary to Red River and thus to the Mississippi) about 3 miles east of Vernon.

ENNIS CREEK.—Scurry County; rises 5 miles east of Fullerville in northeastern part of county; flows southeasterly 16 miles into Rough Creek (tributary through Double Mountain Fork of Brazos River to the Brazos).

Epps Creek.—Kimble and Sutton counties; small stream flowing through the northwestern part of Kimble and northeastern part of Sutton counties into Copperas Creek (tributary to North Llano River and thus through the Llano to Colorado River); length, 11 miles. Fort McKavett topographic map.

Escondido Creek.—Karnes County; near Karnes City in southern part of county; flows easterly 9 miles into San Antonio River and thus to the Guadalupe.

Escondido Creek.—Bexar County; rises 10 miles northeast of San Antonio; flows southeasterly into Cibolo Creek (tributary to San Antonio River), then to Guadalupe River and thus to Gulf of Mexico; intermittent. San Antonio topographic map.

Esparanzos Creek.—La Salle and McMullen counties; rises in the northeastern part of La Salle County; flows southeastward 8 miles through La Salle County, then 9 miles through McMullen County into Frio River (tributary to Nueces River) about 12 miles above Tilden.

Espada Creek.—Webb County; an intermittent stream rising in the western part of county and flowing southward approximately 10 miles into Rio Grande.

Espio Creek.—Dimmit and Lasalle counties; rises in northeastern part of Dimmit County; flows southeastward to its junction with Nueces River in La Salle County; length, 12 miles.

Ettas Creek.—Borden and Scurry counties; rises in the northeastern corner of Borden County; flows southeastward about 22 miles into North Fork of Colorado River (and thus to the Colorado) north of Knapp in the southwestern part of Scurry County.

Evans Creek.—Val Verde County; small stream rising about 4 miles northeast of Comstock and taking a southeasterly course to its junction with Devils River (tributary to Rio Grande) near the town of Devils River; approximate length, 16 miles.

Everett or Thickety Creek.—Jasper and Newton counties; rises about 5 miles southeast of the town of Jasper in Jasper County; flows southeasterly 18 miles; enters White Oak Creek (tributary to Big Crow Creek and thus to Sabine River) in central part of Newton County.

Ewings Lakes.—Dallam County; a series of small lakes in northern part of county; outlet, Rabbit Ear Creek.

Fairchild Creek.—Fort Bend County; a stream flowing southeasterly 10 miles into Big Creek (tributary to Brazos River) south of the town of Richmond.

Fairmounts Creek.—Borden County; small tributary to Colorado River in the southeastern part of county; length, 4 miles.

Fall Creek.—Blanco and Travis counties; small stream rising near Shovel Mountain in the northeastern part of Blanco County; flows southeasterly 9 miles into Pedernales River (tributary to Colorado River) at Turners Crossing. Blanco topographic map.

Fall Creek.—Bosque and Hamilton counties; rises near Fairy; flows northeasterly 7 miles into Bosque River (tributary to the Brazos) 4 miles southwest of Iredell in western part of Bosque County. Meridian topographic map.

Fall Creek.—Hood County; rises 3 miles west of Cresson in northeastern part of county; flows southerly 12 miles into Brazos River at North Arm of "DeCordova Bend." Weatherford and Granbury topographic maps.

Fall Creek.—Kerr and Gillespie counties; rises north of Ingram; small stream flowing into Johnson Creek and thus to the Guadalupe. Kerrville topographic map.

FALL CREEK.—Kimble County; small stream flowing northward 10 miles to its junction with East Fork of James River (tributary to James and Llano rivers, and thus to the Colorado), in eastern part of the county. Kerrville topographic map.

FALL CREEK.—Llano and San Saba counties; rises 3 miles northeast of Wilberns Glen; flows easterly 13½ miles along San Saba-Llano county line into Colorado River; partially intermittent. Llano and Burnet topographic maps.

FALLS CREEK.—Garza County; rises 2 miles northwest of Dugger; flows easterly 6 miles into North Fork of Double Mountain Fork of Brazos River (tributary through Double Mountain Fork of the Brazos to Brazos River) 6 miles northeast of Post in central part of county.

FANNING CREEK.—Hunt County; small tributary to Cowleach Fork of Sabine River (thence to Sabine River through Caddo Fork of the Sabine) in southeastern part of county.

FARMERS BRANCH.—Dallas County; rises about 3 miles south of Frankford; northwestern part of county; flows southwesterly 7 miles into Elm Fork of Trinity River (tributary to Trinity River) 2½ miles southwest of the town of Farmers Branch. Dallas topographic map.

FARMERS CREEK.—Montague County; rises about 3 miles west of Saint Jo in eastern part of county; flows northerly 25 miles into Red River (tributary to the Mississippi) about 2½ miles southeast of Old Spanish Fort. Montague topographic map.

FARMERS CREEK.—Wilbarger and Wichita counties; rises north of Harrold in northeastern part of Wilbarger County; flows easterly 3 miles into Red River (tributary to the Mississippi) in northwestern part of Wichita County.

FARRERS CREEK.—King County; rises in northern part of county; flows easterly 14 miles into Middle Fork of Wichita River (tributary through North Wichita River to the Wichita and thus through Red River to the Mississippi) in the northeastern part of the county.

FARRIS CREEK.—Bosque County; a small intermittent stream flowing southerly 3 miles into Steele Creek (tributary of Brazos River) northwest of Morgan in northern part of county. Granbury topographic map.

FAULKEY GULLY.—Harris County; rises in northwestern part of county 2 miles northwest of Neidorff School; flows southeasterly 6½ miles into Cypress Creek (tributary to Spring Creek, thence to San Jacinto River and thus through Galveston Bay to Gulf of Mexico); intermittent. Rose Hill, Louetta, and Satsuma topographic maps.

FERRIS FORK OF CEDAR CREEK.—Van Zandt and Kaufman counties; rises near Cobbs in northeastern part of Kaufman County; flows circuitously southeastward through Kaufman and Van Zandt counties, then southwesterly into Cedar Creek (tributary to Trinity River) in the southeastern part of Kaufman County; length, 27 miles.

FIELD CREEK.—Llano and San Saba counties; near the town of Field Creek; small stream 5 miles in length, flowing through San Fernando Creek into the Llano (and thus to Colorado River) in the northwestern part of Llano County. Llano topographic map.

FIELDER BRANCH.—King County; rises in northern part of county; flows into Middle Fork of Wichita River (tributary through North Wichita River to Wichita and thus through Red River to the Mississippi).

FIELDERS CREEK.—Val Verde County; an intermittent stream rising in northwestern part of county near county line between Crocket and Val Verde counties, flowing southwesterly 12 miles to its junction with Howards Creek (tributary to Pecos River and thus to Rio Grande) northwest of Pandale.

FIFTH CREEK.—Lipscomb County; an intermittent stream 7 miles long flowing into Wolf Creek (tributary through North Fork of Canadian to Canadian River and thus through the Arkansas to Mississippi River) 2 miles west of Lipscomb in central part of county.

FIRST CREEK.—Lipscomb County; an intermittent stream flowing southeasterly 7 miles into Wolf Creek (tributary through North Fork of Canadian River to the Canadian and thus through the Arkansas to the Mississippi) 5 miles northeast of Valley Park, in western part of county.

FIRST ELM CREEK.—Lasalle County; small stream in western part of county; flows southeasterly to its junction with Las Raices Creek (tributary to Nueces River).

FIRST YEGUA CREEK.—Burleson, Lee, and Milam counties; rises near the town of Rockdale; flows southeasterly 29 miles along Burleson-Lee county line to its junction with Second Yegua Creek, forming Yegua Creek (tributary to Brazos River) about 5 miles southeast of Dime Box, in southeastern part of Lee County. Taylor topographic map.

FISH CREEK.—Angelina County; small tributary to Cypress Creek, and thus to Neches River south of Dunkin in southeastern part of county.

FISH CREEK.—Cooke County; formed about 6½ miles east of Marysville in northern part of county by junction of North and South Fish Creek; flows northeasterly 2½ miles into Red River (tributary to the Mississippi). Gainesville topographic map.

FISH CREEK.—Nolan and Runnels counties; rises 5 miles northwest of Hylton in the southeastern part of Nolan County; flows southeastward 16 miles into Valley Creek (tributary to Colorado River) 9 miles east of Fort Chadbourne. Sweetwater topographic map.

FISH CREEK.—Tarrant and Dallas counties; rises 2 miles south of Johnson Station in Tarrant County; flows northeasterly 12 miles into Mountain Creek (tributary to West Fork of Trinity River, and thus to Trinity River) about 4 miles southeast of Grand Prairie in Dallas County. Fort Worth and Dallas topographic maps.

FISH CREEK.—Falls County; rises near Falls-McLennan county line; flows southwesterly 8 miles into Brazos River.

FISH CREEK.—Young County; rises 2 miles northwest of Murray in southwestern part of county; flows eastward 3 miles into Brazos River 4 miles northwest of mouth of Clear Fork of Brazos River.

FISH CREEK.—Shackelford County; rises 8 miles northwest of Albany; flows northwesterly 13 miles to its junction with Clear Fork of Brazos River (tributary to the Brazos) in northwestern part of county. Anson and Albany topographic maps.

FISH OR EAST FORK OF HUBBARD CREEK.—Eastland and Shackelford counties; rises 8 miles south of Bremen; flows northerly 22 miles into Battle Creek (tributary to Bear Creek and thus through Sandy, Hubbard, and Gonzales creeks to Clear Fork of Brazos and Brazos rivers) in southeast corner of Shackelford County. Albany topographic map.

FISH POND CREEK.—Waller County; rises near Gladish; flows southerly 15 miles into Brazos River, 7 miles south of Hempstead in western part of county.

FISH SPRING BRANCH.—Johnson County; small stream flowing into Mountain Creek (tributary to West Fork of Trinity River, and thus to the Trinity) about 3 miles northeast of Alvarado. Cleburne topographic map.

FISH OR BRUSHY LAKE.—Bowie County; about 6 miles north of Hooks Post Office in northeastern part of county; outlet, Red River (tributary to the Mississippi); formerly a channel of Red River; very small.

FITZGERALD CREEK.—Concho County; a stream 11 miles in length flowing into Brady Creek (tributary to San Saba River and thus to the Colorado) southwest of Eden in the southern part of the county. Eden topographic map.

FIVEMILE CREEK.—Dallas County; rises about 2 miles south of Hale in south central part of county; flows southeasterly 13 miles into Trinity River 2 miles northeast of Hutchins. Dallas topographic map.

FIVEMILE CREEK.—Dewitt County; rises in southern part of county; tributary through Cottonwood and Coleto creeks to Guadalupe River.

FIVEMILE CREEK.—Edwards County; a small intermittent tributary to West Nueces River (thence to the Nueces) in southern part of county; flows easterly 7 miles. Nueces topographic map.

FIVEMILE CREEK.—Gonzales County; rises in south-central part of county 6 miles south of Gonzales; flows southerly 16 miles into Sandies Creek (tributary to the Guadalupe) near southeastern county line.

FLAG BRANCH.—Jones County; rises 3½ miles northeast of Sandersville in northeastern part of county; flows northeasterly 10 miles into California Creek (tributary through Clear Fork of Brazos to Brazos River) west of Old Nabors. Anson topographic map.

FLAG CREEK.—Gillespie County; 6 miles east of Harper in the southwestern part of county; tributary through the Pedernales to Colorado River; length, 6 miles. Kerrville topographic map.

FLAG CREEK.—Llano County; an intermittent tributary through Llano River to the Colorado in central part of county southwest of Llano; length, 7 miles. Llano topographic map.

FLAG CREEK.—Bosque and Erath counties; rises at Flag Creek Gap in the southeastern corner of Erath County; flows easterly into East Bosque River (tributary to Bosque River and thus to the Brazos) 4 miles west of Walnut in the western part of Bosque County. Granbury topographic map.

FLAT BRANCH.—Llano County; small intermittent stream flowing into Wolf Creek (tributary to Pecan Creek, thence to Llano River and thus to the Colorado) 4 miles west of Babyhead. Llano topographic map.

FLAT CREEK.—Blanco County; west of Shingle Hills; flows into Pedernales River (tributary to Colorado River) in eastern part of county; length, 8 miles. Blanco topographic map.

FLAT CREEK.—Cass County; rises about 2 miles south of Munz in northwestern part of Cass County; flows southeasterly 14 miles into Black Cypress Bayou (tributary to Big Cypress Bayou, thence through Caddo Lake and Red River to the Mississippi) about 4 miles east of Jefferson in southern part of Marion County.

FLAT CREEK.—Cooke County; an intermittent stream flowing into Cedar Creek (tributary to Elm Fork of Trinity River and thus to the Trinity) south of Hood. Gainesville topographic map.

FLAT CREEK.—Edwards County; a small intermittent tributary in southern part of county; unites with West Nueces River (thence to Nueces River) about one mile below Kickapoo Spring; flows northeasterly 7 miles. Nueces topographic map.

FLAT CREEK.—Erath and Comanche counties; rises in extreme western part of Erath County; flows southerly 8 miles into Leon River (tributary through Little River to the Brazos) 5 miles north of DeLeon in northern part of Comanche County. Eastland and Stephenville topographic maps.

FLAT CREEK OR WEST FORK OF NECHES RIVER.—Henderson County; rises about 4 miles northeast of Athens; flows easterly 22 miles into Neches River.

FLAT CREEK.—Llano and San Saba counties; rises north of Wilberns Glen near the San Saba-Llano county line; flows easterly 14 miles, crosses the San Saba-Llano county line several times and empties into Colorado River in the extreme southeastern corner of San Saba County 3 miles northwest of Tow. Llano and Burnet topographic maps.

FLAT CREEK.—McLennan County; rises 2 miles northwest of Hewitt in central part of county; flows easterly 15 miles into Brazos River. Temple topographic map.

FLAT ROCK BRANCH.—Throckmorton County; rises 6 miles southwest of Throckmorton; flows southerly 6 miles into Clear Fork of Brazos River (tributary to Brazos River).

FLAT ROCK CREEK.—Blanco and Burnet counties; rises 2 miles north of Round Mountain in the northern part of Blanco County; flows northward 8½ miles into Colorado River 1 mile southeast of Marble Falls in the southern part of Burnet County. Blanco and Burnet topographic maps.

FLAT ROCK CREEK.—Kendall County; rises east of Comfort; flows through western part of county into Guadalupe River.

FLAT ROCK CREEK.—Kinney County; rises near north line of county; flows southerly 10 miles into West Fork of Sycamore Creek (tributary to Sycamore Creek and thus to Rio Grande) in the northwestern part of county.

FLAT ROCK CREEK.—Lee County; rises 2 miles north of Ledbetter; flows northeastward 5 miles into Nails Creek (tributary through Cedar Creek to Yegua Creek and thus to Brazos River).

FLAT ROCK CREEK.—Somervell County; rises near the village of Hill Creek in southern part of county; flows northeasterly 16½ miles into Brazos River 4 miles southeast of Glenrose. Granbury topographic map.

FLAT ROCK CREEK.—Stephens County; a southeasterly flowing stream 4 miles in length joining North Palo Pinto Creek (tributary to Palo Pinto Creek and thus to Brazos River) 6 miles north of Ranger in southern corner of county; Breckenridge topographic map.

FLAT ROCK CREEK.—Throckmorton County; a southeastward flowing stream 3 miles long joining Elm Creek (which discharges into Brazos River) near Williamsburg in northern part of county.

FLEMING OR CANEY CREEK.—Cass and Morris counties; rises about 2 miles north of Naples in northern part of Morris County; flows northeasterly into Jennings Lake (tributary to Sulphur River which discharges into the Mississippi through Red River) in northwestern part of Cass County; length, 4 miles. Daingerfield topographic map.

FLINT CREEK.—Coryell County; a small stream flowing southeasterly 4 miles into Turkey Creek (tributary to Leon River and thus through Little River to the Brazos) in southeastern part of county. Gatesville topographic map.

FLINT CREEK.—Young County; rises in eastern part of county; flows southwestward 12 miles into Salt Creek (tributary to Brazos River) 2 miles northwest of Graham.

FLINT ROCK CREEK.—Young County; a small stream flowing southwesterly 5 miles into Brazos River 3 miles south of Graham.

FLORES BAYOU.—Brazoria County; rises near Angleton in central part of county; flows southeasterly 11 miles into Austin Bayou, thence to Bastrop Bay and Gulf of Mexico.

FORKY DEER CREEK.—Leon County; rises 3 miles northwest of Flynn; flows southwesterly 12 miles into Navasota River (tributary to the Brazos) in southwestern part of county.

Fort White Creek.—Grayson and Collin counties; rises 2 miles southwest of Howe; flows southwesterly 11 miles into East Fork of Trinity River (tributary to Trinity River) about 2 miles east of Weston in Collin County.

Foster Branch.—McLennan County; rises 3 miles northeast of Moody; flows northeasterly into south Cow Bayou (tributary to North Cow Bayou, thence to Cow Bayou, and thus to the Brazos); partially intermittent. Temple topographic map.

Fourmile Creek.—Kent County; small stream flowing northeasterly 8 miles into Salt Fork of Brazos River (tributary to the Brazos) 4 miles northwest of Clairemont.

Fourmile Creek.—Jasper County; rises 4 miles northwest of Jasper; flows southerly 5 miles into Sandy Creek (tributary to Neches River) about 2 miles southwest of Jasper.

Fourmile Draw.—Presidio County; rises 8 miles northwest of Marfa in northern part of county; flows southeasterly 10 miles into Alamita Creek (thence to Rio Grande) 4 miles south of Marfa; intermittent. Marfa topographic map.

Fourth Creek.—Lipscomb County; an intermittent stream rising 13 miles north of Lipscomb and flowing southerly into Wolf Creek (tributary to North Fork of Canadian River and thus through Canadian and Arkansas rivers to the Mississippi) 3 miles west of Lipscomb near center of county.

Foyle Creek.—Shackelford County; rises 10 miles northwest of Albany in north central part of county; flows easterly 20 miles into Clear Fork of Brazos River (tributary to Brazos River) 2 miles west of Stephens-Shackelford county line. Albany topographic map.

Francisco Perez Creek.—Medina County; rises in southern part of county; flows southward 14 miles into Rosales or Chacon Creek (tributary to Nueces River through San Miguel and Frio rivers) on Frio-Medina county line.

Frazier Canyon.—Jeff Davis County; rises 8 miles northwest of Fort Davis in Davis Mountains; flows northeastward 12 miles to its junction with Limpia Creek (thence through Paisano Creek to Pecos River and thus to Rio Grande); intermittent. Fort Davis topographic map.

Frazier Creek.—Jasper County; small stream flowing into Neches River about 6 miles north of Evadale.

Frazier Creek.—Cass County; rises about 3 miles north of Almira in western part of county; flows southeasterly 26 miles into Jim Bayou (tributary to Caddo Lake, thence through Red River to the Mississippi) near its intersection with south line of county. Linden and Atlanta topographic maps.

Freestone Creek.—Clay and Montague counties; rises near Newport in southeastern part of Clay County; flows southeasterly into Big Sandy Creek (tributary to West Fork of Trinity River and thus to the Trinity) in the southwestern corner of Montague County.

French Creek.—Bexar County; an intermittent stream; flows into Leon Creek (tributary through Medina River to San Antonio River and thus to the Guadalupe) northwest of San Antonio. San Antonio topographic map.

French Creek.—Uvalde County; small intermittent tributary to East Nueces River (thence to the Nueces) in northwestern part of county; length, 5 miles. Brackett topographic map.

French John Creek.—Llano County; an intermittent stream flowing into Llano River (tributary to Colorado River) 4 miles northwest of Kingsland in southeastern part of county; length, 3 miles. Burnet topographic map.

Fresno Creek.—Brewster County; rises on eastern side of Chisos Mountains 10 miles north of Reed Camp in southern part of county; flows southeasterly into Rio Grande at Solis Ranch. Chisos Mountains topographic map.

Fresno Creek.—Presidio County; small stream rising in southeastern part of county and flowing southerly into Rio Grande 5 miles northwest of Lajitas. Terlingua topographic map.

Frio Creek.—Castro and Swisher counties; rises about 6 miles northeast of Nazareth in eastern part of Castro County; takes an eastward course about 23 miles, enters Tule Creek (tributary to Prairie Dog Town Fork of Red River, thence to Red River, and thus to the Mississippi) 5 miles northeast of Tulia in central part of Swisher County; dry channel carrying flood waters only at rare intervals; course and origin not well defined.

Frio River.—Rises in north central part of Real County; flows southeasterly and easterly traversing Real County 32 miles, Uvalde County 50 miles, Frio County 40 miles, La Salle County 25 miles, McMullen County 34 miles, and Live Oak County 16 miles, uniting with Atascosa River at Three Rivers and flowing into Nueces River 2 miles south of Three Rivers, near central part of Live Oak County; length 200 miles; drainage area, 7,310 square miles. The stream is of considerable economic value and use is made of its waters for irrigation and domestic purposes at a number of points (see Nueces River). Gaging stations maintained at Derby and Fowlerton. Uvalde topographic map.

Frisco Creek.—Hansford County; rises in northwestern part of county; flows northerly into Coldwater Creek (tributary to Beaver River and thus through North Fork of Canadian, Canadian, and Arkansas Rivers to the Mississippi) in southern part of Texas County, Okla.

Frog Creek.—Clay County; an intermittent stream flowing into Red River (tributary to the Mississippi) in northern part of county east of Byers.

Frog Pond Creek.—Concho County; rises in western part of county; flows 12 miles into Kickapoo Creek and thus to Concho River (tributary to the Colorado). San Angelo topographic map.

Fulcher Creek.—Dewitt County; small tributary to Guadalupe River northwest of Hochheim in northern part of county.

Fuzzy Creek.—Runnels and Concho counties; a stream 11 miles long in northeastern part of Concho County and southeastern part of Runnels County north of Paint Rock; flows into Concho River and thus to the Colorado. Ballinger topographic map.

Gabler Creek.—Garza County; a stream 4 miles long rising in southeastern part of county and flowing southerly into Double Mountain Fork of Brazos River (tributary to the Brazos).

Gageby Creek.—Hemphill and Wheeler counties; rises in northwestern part of Wheeler County; flows northeasterly about 15 miles into Washita River (tributary to Red River and thus to the Mississippi) about 3 miles southwest of Gem in southern part of Hemphill County.

Gages Creek.—Young County; a stream flowing southeasterly 4 miles into Clear Fork of Brazos River (tributary to Brazos River) near Eliasville in southern part of county. Breckenridge topographic map.

Gallion Creek.—Sabine County; small stream in southwestern part of county; flows into Devils Ford Creek (thence to Bear Creek, Ayish Bayou, Angelina, and Neches rivers) in southwestern part of county.

Gallinas Creek.—Atascosa County; rises in northeastern part of county; flows southward 12 miles into Atascosa River (tributary to Frio River and thus to the Nueces) 2 miles east of Pleasanton.

Gap Creek.—Brown County; a stream 5 miles long southeast of Clio in the eastern part of the county; flows into Salt Creek (tributary to Pecan Bayou and thus to the Colorado). Brownwood topographic map.

Gap Creek.—Runnels County; rises in northeastern part of county 3 miles southwest of Content; flows southwesterly 10 miles into Elm Creek (tributary to Colorado River); partially intermittent. Abilene and Ballinger topographic maps.

Gapher Creek.—Borden County; small stream 5 miles long in northeastern part of county; flows into Ettas Creek and thus through North Fork of Colorado River to the Colorado.

Gariolas Creek.—Victoria County; rises in northern part of county; flows southeasterly 21 miles into Arenosa Creek (thence to Gulf of Mexico through Lavaca and Matagorda bays).

Garcia Creek.—Terrell County; rises in southwestern part; flows southwesterly 4½ miles into Sanderson Canyon (tributary to Rio Grande); intermittent. Dryden Crossing topographic map.

Gary Creek.—Bosque County; a southeastward flowing stream 8 miles long, joining Neil Creek (tributary to Bosque River and thence to the Brazos) southeast of Norse in southern part of county. Meridian topographic map.

Garrett Creek.—Wise County; joins Boggy Creek (which discharges through West Fork of Trinity River into the Trinity) in central part of county.

Garrett Creek.—Grimes and Montgomery counties; rises in eastern part of Grimes County; flows southeasterly 5½ miles through Grimes County; then ½ mile through Montgomery County into Lake Creek (tributary to West San Jacinto River, thence to San Jacinto River and Gulf of Mexico).

Garretts Creek.—Hopkins and Rains counties; rises in southwestern part of Hopkins County; flows southerly about 14 miles into Lake Fork of Sabine River (tributary to the Sabine) in northern part of Rains County.

Gasconades Creek.—Coke and Sterling counties; rises in the northeast corner of Sterling County; flows easterly 12 miles into Colorado River in northwest corner of Coke County.

Gassey Creek.—Childress County; rises about 5 miles west of Childress; flows northerly 9 miles into Prairie Dog Town Fork of Red River (tributary to the Red and thus to Mississippi River).

Gato Creek.—Uvalde and Zavalla counties; a small intermittent tributary rising 2 miles south of Cline Mountains and flowing into Chapparosa Creek (thence to Nueces River through Turkey and Elm creeks) in the southwestern part of Uvalde County and the northwestern part of Zavalla County; length, 14 miles. Brackett topographic map.

Gaxley Creek.—Bastrop County; small intermittent tributary uniting with Colorado River in the town of Smithville in southeastern part of county; length, 4 miles. Bastrop and Faltonia topographic maps.

Gee Branch.—Hill and Johnson counties; rises in southern part of Johnson County; flows southerly 6 miles into Aquilla Creek (tributary to Brazos River) 2 miles south of Covington in northern part of Hill County. Cleburne topographic map.

Gentry Creek.—Jack and Wise counties; rises about 2 miles east of Joplin in Jack County; flows northeasterly 14 miles into West Fork of Trinity River (tributary to the Trinity) near Bridgeport in the central part of Wise County.

George Creek.—Somervell and Johnson counties; rises 3 miles west of Bono in southwestern part of Johnson County; flows southwesterly 8 miles into Brazos River, 2½ miles southwest of "Georges Creek" in eastern part of Somervell County. Granbury topographic map.

GERONIMO CREEK.—Edwards County; a small intermittent tributary to West Nueces River (thence to the Nueces) in western part of county; flows southeasterly 6 miles. Nueces topographic map.

GERONIMO CREEK.—Guadalupe County; rises northwest of Geronimo in the northwestern part of county; flows southeasterly 15 miles into Guadalupe River about 4 miles southeast of Seguin in central part of county. San Marcos topographic map.

GERONIMO CREEK.—Medina County; northeastern part of county; an intermittent stream joining Medina River (tributary to San Antonio River and thus to the Guadalupe) 4 miles north of Castroville.

GHOLSON CREEK.—Garza County; rises 2 miles southeast of Southland; flows easterly 9 miles into North Fork of Double Mountain Fork of Brazos River (tributary to Double Mountain Fork of the Brazos, thence to the Brazos) in northwestern part of county.

GIBBONS BRANCH.—Cooke County; a small intermittent tributary to Elm Fork of Trinity River (which discharges into the Trinity) west of the town of Muenster in southwestern part of county. Gainesville topographic map.

GIBBONS CREEK.—Grimes County; a small stream flowing southwesterly into Smith Creek (tributary to Ben Fort Creek and thus througth Navasoto River to the Brazos); length, 5 miles.

GIBSON CREEK.—Ochiltree and Lipscomb counties; rises in southeastern corner of Ochiltree County; flows northeasterly into Wolf Creek (tributary to North Fork of Canadian River, and thus through the Canadian and Arkansas river to the Mississippi) one mile south of Valley Park, western part of Lipscomb County.

GIBSON CREEK.—Palo Pinto and Erath counties; rises near Harriet Mountain in northern part of Erath County; flows northerly 9 miles into Palo Pinto Creek (tributary to Brazos River) 3 miles northeast of Mingus in southwestern part of Palo Pinto County. Stephenville and Palo Pinto topographic maps.

GIDDINGS OR NAILS CREEK.—Lee County; rises at Giddings; flows northeasterly 20 miles into Yegua Creek (tributary to Brazos River).

GILADON CREEK.—Van Zandt County; rises at Edgewood; flows northeasterly 12 miles into Sabine River about 4 miles northwest of Grand Saline.

GILBERT CREEK.—Wichita County; rises about 9 miles northwest of Iowa Park in northern part of county; flows easterly 15 miles into Red River (tributary to the Mississippi) 3½ miles west of northeastern corner of county.

GILHULA CREEK.—Ochiltree and Lipscomb counties; rises 12 miles east of Ochiltree; flows southeasterly 10 miles into Wolf Creek (tributary to North Fork of Canadian River and thus through Canadian and Arkansas rivers to the Mississippi) 3 miles east of Valley Park in western part of Lipscomb County.

GILL CANYON.—Presidio County; an intermittent stream 5 miles long flowing into Rio Grande 3 miles north of Upper San Antonio, Mexico. San Carlos topographic map.

GILLELAND CREEK.—Travis County; rises 4 miles north of Pflugerville in northern part of county; flows southeasterly 21 miles into Colorado River one mile west of Webberville. Austin topographic map.

GILLS CREEK.—Bastrop County; rises 2 miles northeast of Bastrop; flows southwesterly 2½ miles into Colorado River just below Bastrop; intermittent. Bastrop topographic map.

GILMORE CREEK.—Erath County; a stream 8 miles long flowing northeasterly into Spring Creek (tributary to Bosque River and thus to the Brazos) 4 miles west of Hico in southern part of county. Hamilton topographic map.

GINHOUSE LAKE.—Bowie County; about 6 miles north of Hooks Post Office in northeastern part of county; formed by an old channel of Red River (tributary to the Mississippi); very small.

GIBANDS CREEK.—Martin, Howard, and Mitchell counties; rises near Stanton in the southeastern corner of Martin County; flows easterly 10 miles through Martin County, 32 miles through Howard County, then 20 miles through Mitchell County into the Colorado 9 miles southeast of Spade in the southern part of Mitchell County.

GIVEN CREEK.—Throckmorton and Stephens Counties; flows southeasterly 11 miles into Clear Fork of Brazos River (tributary to the Brazos) in the northwest corner of Stephens County. Albany topographic map.

GLADE CREEK.—Hopkins and Franklin counties; rises in southeastern part of Hopkins County; flows northeastward into Big Cypress Creek (tributary to Caddo Lake, thence to Red River and thus to the Mississippi) in southwestern part of Franklin County.

GLADE OR PRAIRIE CREEK.—Upshur and Gregg counties; rises east of Glenwood in southeastern part of Upshur County; flows northeasterly 4 miles into Little Cypress Creek (tributary to Caddo Lake and thus to Red and Mississippi rivers) at the northern boundary of Gregg County.

GLADE CREEK.—Wood County; flows southwesterly about 5 miles into Lake Fork of Sabine River (tributary to the Sabine) in central part of county.

GLADES CREEK.—Upshur and Gregg counties; rises about 5 miles southwest of Gilmer in Upshur County; flows southeasterly 13 miles into Sabine River in the northwestern corner of Gregg County near Gladewater.

GLENN CREEK.—El Paso County; rises 6 miles south of Dalberg; flows southerly 16 miles into Rio Grande, 20 miles south of Dalberg in the extreme southeastern corner of the county. Chispa topographic map.

GLENWOOD CREEK.—Donley County; rises about 2½ miles southeast of Evans in northern part of county; flows southerly 10 miles into Saddlers Creek (tributary to Salt Fork of Red River and thus through Prairie Dog Town Fork of the Red to Red River and thence to the Mississippi).

GLENN DRAW.—Brewster County; flows southeasterly 16 miles into Rio Grande 15 miles west of Boquillas in southern part of county; intermittent. Chisos Mountains topographic map.

GOAT CREEK.—Brewster County; rises between Goat and Cienega mountains 15 miles south of Alpine; flows southerly 15 miles to Maravilla Creek (tributary to Rio Grande). Alpine topographic map.

GOAT CREEK.—Kerr and Gillespie counties; small tributary to Guadalupe River northwest of the town of Kerrville. Kerrville topographic map.

GODLEY CREEK.—Bowie County; rises approximately 5 miles southwest of New Boston; flows southerly 4 miles into Anderson Creek (tributary through Sulphur River to Red River and thus to the Mississippi) about 2 miles north of Sims in western part of county. New Boston topographic map.

GOLDMINE CREEK.—Llano County; rises west of Oxford; flows through southern part of county into Sandy Creek and thus to Colorado River; length, 4 miles. Llano topographic map.

[illegible] western corner of [illegible] southeastward [illegible] miles through Wharton County [illegible] tributary to Navi[illegible] Bay and thus to Gulf of [illegible]

[illegible] rises in southeastern part [illegible] stream of Attoyac Bayou [illegible]

[illegible] miles northwest of Wayland by [illegible] Creek in southern part [illegible] Clear Fork of Brazos River [illegible] Falls in northern [illegible] Breckenridge topographic map.

[illegible] rises near southern Eastland [illegible] miles into Gonzales Creek (tributary to Clear Fork of Brazos River and thus to the Brazos) 2 miles north of [illegible] map.

Gonzales Creek, West Fork.—[illegible] County; rises near Gunsight Mountain [illegible] with Middle Fork of Gonzales Creek [illegible] Clear Fork of Brazos River and thus to the Brazos [illegible] of Wayland, in southern part of [illegible]

Gonzales Creek, Middle Fork.—[illegible] County; rises near southern Eastland County [illegible] junction with West Fork [illegible] Clear Fork of Brazos River [illegible] of Wayland in southern part of [illegible] topographic maps.

[illegible] Creek.—[illegible] flows southeastward 4 miles [illegible] River and thus through Red River to the Mississippi.

[illegible] Creek.—[illegible] stream flowing northerly 4 miles [illegible] Creek [illegible] Yegua Creek to Yegua Creek and thus to Brazos River [illegible] Bastrop topographic map.

[illegible] Creek.—Baylor and Archer counties; rises in eastern part of Baylor County; flows northeastward [illegible] North Fork of Little Wichita River [illegible] Wichita River and thus through Red River to the Mississippi [illegible] Baylor-Archer County line, in western part of Archer County.

Goose Branch.—Erath County; rises [illegible] of Lingleville, in western part of county; [illegible] South Bosque River (tributary to Bosque River and thus to the Brazos). Stephenville topographic map.

Goose Creek.—Harris County; small [illegible] stream rising in southeastern part of county and flowing southerly 4 [illegible] San Jacinto Bay, thence through Trinity Bay into Galveston Bay and Gulf of Mexico. Burnett Bay, Cedar Bayou, and Morgan Point topographic maps.

Gordon's Branch.—Lee County; a small intermittent stream flowing northerly 4 miles into Second Yegua Creek (tributary to Yegua Creek and thus to Brazos River), in western part of county. Bastrop topographic map.

Gourd Creek.—Houston County; a small tributary to Trinity River in the western part of the county.

Grace Creek.—Gregg County; rises about 6 miles north of Longview; flows southerly 9 miles into Sabine River about 3 miles south of Longview.

Gragg Creek.—Red River County; rises about 4 miles northeast of Clarksville; flows southeasterly 9 miles into Kickapoo Creek (tributary to Cuthand Creek and thus through Sulphur and Red Rivers to the Mississippi).

Granie Creek.—Shelby County; rises 4 miles southeast of Shelbyville; flows northerly 5 miles, thence easterly 12 miles into Sabine River.

Granite Creek.—Harris County; a continuation of Spring Gully, 3½ miles southwest of Crosby; flows easterly one-half mile into San Jacinto River (tributary to Gulf of Mexico); intermittent. Crosby topographic map.

Grand Saline Creek.—Van Zandt County; rises about 3 miles south of Canton, in central part of county; flows northeasterly 22 miles into Sabine River 1 mile northeast of Silver Lake.

Grannys Branch.—Eastland County; rises 1½ miles northwest of Carbon; flows northerly into South Fork of Leon River (tributary through Middle Fork of the Leon, Leon, and Little rivers, to the Brazos) near Mangum, in central part of county. Eastland topographic map.

Grape or Yellow Wolf Creek.—Coke County; rises about 3 miles northeast of Sanco; flows southerly 12 miles into Colorado River, 6 miles northwest of Robert Lee.

Grape Creek.—Llano County; small tributary through Sandy Creek to Colorado River west of Oxford in southern part of county; length, 4 miles. Llano topographic map.

Grape Creek.—Mason County; an intermittent stream rising northeast of Katemcy in northern part of county; flowing 5 miles into Tiger Creek (tributary to San Saba River, and thus to the Colorado). Mason topographic map.

Grape Creek.—Runnels and Coleman counties: in the southwestern part of Coleman County and southeastern part of Runnels County south of Talpa; flows 18 miles into Colorado River. Ballinger topographic map.

Grapevine Creek.—Dickens and Motley counties; rises in northwestern part of Dickens County; flows northeasterly 7 miles into Olive Fork of South Pease River (tributary through South and Middle Pease rivers to Pease River, and thus through Red River to the Mississippi) in Motley County, one-fourth mile north of the southern boundary line.

Grapevine Creek.—Gray County; rises near central part: flows easterly 6½ miles into North Fork of Red River (tributary to Red River and thus to the Mississippi) 1 mile south of Lefors.

Grapevine Creek.—Tarrant and Dallas counties; rises about 3 miles southeast of the town of Grapevine in Tarrant County; flows easterly 9 miles into Elm Fork of Trinity River (tributary to Trinity River) about 2 miles southwest of Carrollton in northwestern part of Dallas County. Fort Worth and Dallas topographic maps.

Grass Creek.—Bosque County: a northeasterly flowing stream 6 miles long joining Brazos River opposite the extreme northwest point of Hill County. Granbury topographic map.

Grass Hollow.—Edwards County; a small intermittent tributary to West Nueces River (thence to the Nueces) in western part of county; flows southwesterly 4 miles. Nueces topographic map.

Grass Lake.—Bowie County; about 5 miles southwest of Maude in southern part of county; formed by an old channel of Sulphur River (tributary to Red River and thus to the Mississippi). New Boston topographic map.

Grassy Branch.—Johnson County; small tributary to Mountain Creek (which discharges into West Fork of Trinity River and thus to the Trinity) east of Pleasant Point in northeastern part of county. Cleburne and Fort Worth topographic maps.

[illegible] Creek.—Bastrop County; [illegible] northeast of Paige in the southeastern part of county; [illegible] Pin Oak Creek (tributary to Colorado River); length, 7 miles. Bastrop topographic map.

[illegible] Creek.—Cass County; a small intermittent stream entering Sulphur River (tributary through Red River to the Mississippi) about one-half mile southeast of [illegible] in northeastern part of county. Atlanta topographic map.

[illegible] Creek.—Grimes County; rises 7 miles east of Navasota; flows southwesterly [illegible] miles into Brazos River 7 miles south of Navasota in southwestern part of county.

[illegible] Lake.—Red River County; an old channel lake in southeastern part of county formed by former channel of Sulphur River (tributary to Red River, which discharges into the Mississippi).

Grasshopper Creek.—Wise and Denton counties; rises in southern part of Wise County; flows southeasterly about 30 miles into Clear Creek (tributary to Elm Fork of Trinity River, thence to the Trinity) in northwestern part of Denton County. Gainesville topographic map.

Grassy Lake.—Harris County; small lake 7 miles southeast of Humble; one-[illegible] mile long and [illegible] mile wide. Harmaston topographic map.

Gravelly Creek.—Bastrop County; in the southeastern part of the county; small intermittent tributary through Pin Oak Creek into Colorado River; length, [illegible] miles. Bastrop topographic map.

Green Creek.—Erath County; rises 3 miles south of Lingleville in western part of county; flows southeasterly [illegible] miles through Alexander into Bosque River (tributary to the Brazos) near Clairette. Stephenville topographic map.

Green Creek.—Titus County; rises about 7 miles north of Mount Pleasant; flows northerly [illegible] miles into [illegible] Bayou (tributary to Sulphur River and thus through Red River to the Mississippi).

Green Lake.—Calhoun County; a tidal lake in western part of county; outlet through Mission Lake to Guadalupe Bayou and thus to San Antonio and Guadalupe rivers.

Green Lake.—Donley County; about 3 miles south of Clarendon; outlet, when overflowing, Clam Lake (which discharges through Clarendon Lake to Little Brushy Creek and thus through Salt Fork of Red River to Prairie Dog Town Fork of the Red, thence through Red River to the Mississippi).

Greens Creek.—Bastrop County; small intermittent stream in the southwestern part of county; joins with Cedar Creek (tributary through Walnut Creek to Colorado River) 3 miles east of the town of Cedar Creek; length, 5 miles. Bastrop topographic map.

Greens Bayou.—Galveston County; a short tidal stream, in southwestern part of county; drains into West Galveston Bay, and thus to Gulf of Mexico.

Greens Bayou.—Harris County; rises 9 miles west of Aldine in the central part of county; flows easterly and southeasterly 42 miles into Ship Channel (Buffalo Bayou) thence to Galveston Bay and Gulf of Mexico 1 mile northwest of Penn City; tidal for 7 miles in lower course. Satsuma, Aldine, Humble, Harmaston, and Fauna topographic maps.

Greenbriar Creek.—Brown and Callahan counties; rises 5 miles north of Cottonwood; flows southeasterly 22 miles into Pecan Bayou (tributary to Colorado River) at north end of Coon Mountain. Coleman topographic map.

GREENBRIAR CREEK.—Coryell County; small stream flowing southeasterly 6 miles into Coryell Creek (tributary to Leon River, and thus through Little River to the Brazos) near Pecan Grove in eastern part of county. Gatesville topographic map.

GREENBRIER CREEK.—Montague County; rises about 2 miles southeast of Greenbrier School in northern part of county; flows northerly 5 miles into Farmers Creek (tributary to Red River and thus to the Mississippi) about 2 miles north of Pigtail School. Montague topographic map.

GRIFFIN CREEK.—Kinney County; a small intermittent stream in northeastern part of county; flows easterly 7 miles to its junction with West Nueces River (thence to the Nueces) near Hillcoat Ranch. Nueces topographic map.

GRINDSTONE CREEK.—Freestone County; rises 7 miles southwest of Fairfield; flows northerly 16 miles into Tehuacana Creek (tributary to Trinity River).

GRINDSTONE CREEK.—Parker County; rises 2 miles southwest of Peister in western part of county; flows southerly 16 miles into Brazos River 1½ miles southeast of Brannon's Ferry. Weatherford topographic map.

GROESBECK CREEK.—Hardeman County; formed about 5 miles northwest of Quanah in northern part of county by union of North and South Groesbeck Creeks; flows easterly 10 miles into Red River (tributary to the Mississippi).

GROESBECK CREEK.—Limestone County; rises 5 miles west of Groesbeck; flows southeasterly 15 miles into Navasota River (tributary to Brazos River).

GROESBECK CREEK, NORTH.—Childress and Hardeman counties; rises about 2 miles northeast of Childress in southeastern part of Childress County; flows southeastward 30 miles to its junction with South Groesbeck Creek to form Groesbeck Creek (tributary to Red River and thus to the Mississippi) 5 miles northwest of Quanah in northern part of Hardeman County.

GROESBECK CREEK, SOUTH.—Childress and Hardeman counties; rises in southeastern part of Childress County; flows northeastward 25 miles to its junction with North Groesbeck Creek to form Groesbeck Creek (tributary to Red River and thus to the Mississippi) about 5 miles northwest of Quanah in northern part of Hardeman County.

GUADALUPE RIVER, SOUTH FORK.—Kerr County; headwater stream of Guadalupe River; rises in southern part of county; flows northerly 8 miles to its junction with North Fork of Guadalupe River forming Guadalupe River about 1 mile southeast of Japonica. Kerrville topographic map.

GUADALUPE RIVER, NORTH FORK.—Kerr County; upper tributary to Guadalupe River; rises in western part of county; flows easterly 22 miles to a point 1 mile southeast of Japonica where it unites with South Fork of Guadalupe River to form Guadalupe River. Kerrville topographic map.

GUADALUPE RIVER.—Rises in the western part of Kerr County; flows southeasterly 255 miles traversing the counties of Kerr, Kendall, Comal, Guadalupe, Gonzales, Dewitt, Victoria, Calhoun, and Refugio; empties into San Antonio Bay (an arm of the Gulf of Mexico); area of drainage basin, 6,000 square miles; principal tributaries, Comal and San Marcos rivers, both perennial-flowing spring fed streams, entering Guadalupe River, the former at New Braunfels, the latter at a point 1½ miles southwest of Gonzales, and San Antonio River, which enters this stream a short distance above San Antonio Bay.

A uniform flow from springs along the Balcones escapement makes the stream of power value, and a small percentage of the flow is now utilized [illegible] power [illegible] and there appear to be [illegible]. Above New Braunfels the stream flows through a [illegible] the basin is more level and [illegible] precipitation varies from [illegible] inches at [illegible] inches at Cuero in the lower part of the [illegible]. New Braunfels, Gonzales, and [illegible] and San Marcos topographic maps.

See [illegible] Report of Texas Board of Water Engineers for list of [illegible] drainage.

G[illegible] Creek.—Brewster County; rises in the western part, 2 miles south of Pine [illegible] Rio Grande; intermittent. [illegible] topographic maps.

Guadalupe Bayou.—[illegible] formed by Guadalupe River [illegible] Bay and [illegible] Gulf of Mexico.

Guest Creek.—Red River County; rises [illegible] 2 miles northwest of Detroit in western part of county; flows [illegible] 20 miles into Cuthand Creek (tributary to [illegible] River [illegible] Red River to the Mississippi) 8 miles south of Clarksville.

Gum Gully.—Harris County; rises 4 miles northwest of Crosby near Gum Gully School; flows [illegible] into [illegible] Bayou (tributary to San Jacinto River [illegible]) [illegible] partially intermittent. Crosby topographic map.

Gun Canyon Creek.—Armstrong County; rises in southern part of county; flows southerly 2 miles into Prairie Dog Town Fork of Red River (tributary to Red River and thus to the Mississippi).

Gyp Creek.—Knox County; a small stream 11 miles in length flowing southerly into Brazos River in southern part of county.

Gypsum Creek.—Armstrong County; rises in southern part; flows southeasterly 7 miles into Prairie Dog Town Fork of Red River, thence to Red River and thus to the Mississippi.

Gypsum Creek.—Childress County; a stream 9 miles long flowing southeasterly through the northern part of county into Prairie Dog Town Fork of Red River (which discharges into the Mississippi through Red River).

Gypsum Creek.—Stonewall and Fisher counties; a stream flowing northerly 15 miles into Double Mountain Fork of Brazos River (tributary to the Brazos) in southern part of county about 8 miles southwest of Aspermont. Roby topographic map.

Hackberry Creek.—Briscoe County; rises in northeastern part; flows southeasterly into Prairie Dog Town Fork of Red River (tributary to Red River and thus to the Mississippi); length, 9 miles.

Hackberry Creek.—Dallas County; rises about 2 miles southeast of Gibbs; flows southeasterly 6 miles into Elm Fork of Trinity River (tributary to Trinity River) about 3 miles northwest of Letot. Fort Worth and Dallas topographic maps.

Hackberry Creek.—Edwards County; a small intermittent tributary in western part of county; unites with West Nueces River (tributary to the Nueces) about 1 mile above Black Water Hole; flows southwesterly 9 miles. Nueces topographic map.

Hackberry Creek.—Edwards County; rises in the central part of county; flows southeasterly 18 miles into East Nueces River (thence to the Nueces) forming Devils Sink Hole (headwaters of East Nueces River) 15 miles north of Barksdale. Rock Springs and Nueces topographic maps.

Hackberry Creek.—Edwards County; tributary to Pulliam Creek (tributary to Nueces River) in eastern part of county, about 8 miles northwest of Barksdale; flows southerly 10 miles. Nueces topographic map.

Hackberry Creek.—Erath County; rises 1 mile northwest of Lingleville; flows southwestward 7 miles into Armstrong Creek (tributary through Leon River to Little River and thence to the Brazos) near Armstrong in western part of county. Stephenville topographic map.

Hackberry Creek.—Hill County; rises near Itasca in northern part of county; flows southward 22 miles into Aquilla Creek (which discharges into Brazos River) 2 miles southwest of Vaughan. Cleburne and Waco topographic maps.

Hackberry Creek.—King County; a northerly flowing stream joining Croton Creek (tributary to the Brazos) 6 miles south of Guthrie in Southern part of county; length, 6 miles.

Hackberry Creek.—King County; rises in northwestern part of county; flows southeasterly 5 miles into Willow Creek (tributary to South Wichita River and thus through Wichita and Red rivers to the Mississippi).

Hackberry Creek.—Mitchell and Sterling counties; rises in northern part of Sterling County; flows northward 7 miles into Chrystal Creek (tributary to Girands Creek and thus to the Colorado) in southern part of Mitchell County.

Hackberry Creek.—Motley County; rises in southeastern part of county; flows northerly 5 miles into Teepe Creek (tributary through Middle Pease River to Pease River and thus through Red River to the Mississippi) about 7 miles southwest of Teepee City.

Hackberry Creek.—Uvalde County; small intermittent stream in northern part of county; flows southerly 7 miles into Blanco River (tributary to Sabinal, Frio, and Nueces rivers) 1 mile southeast of Hackberry ranch. Uvalde topographic map.

Hackberry Creek.—Wheeler and Collingsworth counties; rises in southern part of Wheeler County; flows southerly 7 miles into Elm Fork of Red River (tributary through North Fork of Red River to the Red, and thus to the Mississippi) in northern part of Collingsworth County.

Hackley Creek.—Cooke County; small stream flowing into Scott Creek (tributary to Elm Fork of Trinity River, thence to the trinity) south of Fair Plains; intermittent. Gainesville topographic map.

Hagerty Creek.—Harrison County; rises about 2 miles northwest of Scottsville in eastern part of county; flows northerly 11 miles into Caddo Lake (tributary to Red River and thus to the Mississippi) in the northeastern part of the county.

Hairston Creek.—Burnet County; small stream flowing into Hamilton Creek and thus to Colorado River about midway between Burnet and Marble Falls in the southern part of county; length, 7 miles. Burnet topographic map.

Haley Branch.—Johnson County; rises 2 miles south of Bono in western part of county; flows southeasterly 8 miles into Nolands River (tributary to Brazos River) a mile west of the village of Rio Vista. Granbury and Cleburne topographic maps.

Halifax Creek.—Hays County; small intermittent stream northwest of Kyle in eastern part of county; flows into Blanco River (tributary through the San Marcos to Guadalupe River). Blanco and Austin topographic maps.

HALL CREEK.—Donley County; rises about 6 miles southwest of Clarendon; flows southwesterly 7 miles into Big Sandy Creek, thence through Mulberry Creek to Prairie Dog Town Fork of Red River and thus through the Red to Mississippi River.

HALL CREEK.—Floyd and Motley counties; rises in eastern part of Floyd County; flows easterly 3 miles into Pease River (tributary to Red River and thus to the Mississippi) in western part of Motley County.

HALLS BAYOU.—Brazoria and Galveston counties; rises 6 miles northeast of Alvin in eastern part of Brazoria County; flows southeasterly 9 miles through Brazoria County into Galveston County, where it continues its course for 2 miles; recrosses into Brazoria County then flows southwesterly 4 miles into West Galveston Bay (thence to Gulf of Mexico). A short distance above its mouth it widens and forms Halls Lake.

HALLS BAYOU.—Harris County; rises in the north central part of the county; flows southeasterly 11 miles through Greens Bayou into Ship Channel, thence to Galveston Bay and Gulf of Mexico. Aldine, Humble and Settegast topographic maps.

HAM CREEK. Cass County; a small intermittent stream entering Shoal Creek (tributary through Sulphur River to Red River and thus to the Mississippi) about 3½ miles north of Anti School in Northern part of county. Linden topographic map.

HAMILTON CREEK.—Burnet County; rises 4 miles northwest of Burnet in the western part of county; flows southerly 20 miles into Colorado River at Pangle Crossing, 3½ miles east of Marble Falls. Burnet topographic map.

HAMILTON CREEK.—Hays and Travis counties; rises west of Shingle Hills in northern part of Hays County; flows northwestward 4 miles into Pedernales River just below Hamilton Pool post office, and thus to Colorado River. Blanco topographic map.

HAPPY CREEK.—Armstrong County; rises in southwestern part of county; flows northeasterly 9 miles into Prairie Dog Town Fork of Red River, thence to Red River, and thus to the Mississippi.

HARBER OR AIKEN CREEK.—Bowie County; rises about 1 mile southeast of Leary; flows southeasterly 11 miles into Elliott Creek (tributary to Sulphur River and thus through Red River to the Mississippi) about 6 miles west of Draper in southeastern part of county. Texarkana topographic map.

HARDEN BRANCH.—Concho County; a small stream flowing to the west and southwest of Eden in southern part of county; empties into Brady Creek (and thus through San Saba to Colorado River); length, 8 miles. Eden topographic map.

HARDEMAN BRANCH.—Washington County; small intermittent stream flowing into Rocky Creek (tributary to Brazos River) southeast of Independence. Gay Hill topographic map.

HARDYS CREEK.—Lavaca County; rises in southeastern part of county; flows southeastward 12 miles into Navidad River (tributary to Lavaca River, thence to Matagorda Bay and thus to Gulf of Mexico) near Lavaca-Jackson county line.

HARMONS CREEK.—Walker County; rises near the town of Huntsville; flows northeasterly 14 miles into Trinity River near Riverside.

HARRIS BAYOU.—Harris County; rises in southwestern part of city of Houston; flows southeasterly 2 miles into Brays Bayou, thence through Ship Channel to Galveston Bay and Gulf of Mexico.

HARRIS CREEK.—Bowie County; rises about 1½ miles north of Texarkana; flows southerly 3 miles to its junction with Ward Creek 1½ miles south of Texarkana to form Hurricane Creek (tributary to Sulphur River, and thus through Red River to the Mississippi). Texarcana topographic map.

HARRIS CREEK.—Grayson County; rises about 5 miles west of Sherman in central part of county; flows northwesterly 9 miles into Mineral Creek (tributary to Red River and thus to the Mississippi) 2 miles north of Steedman. Denison topographic map.

HARRIS CREEK.—McLennan County; rises 3 miles southwest of McGregor in southwestern part of county; flows northeasterly 12 miles into South Bosque River (tributary to Bosque River and thus to the Brazos) 1½ miles southwest of South Bosque. Temple topographic map.

HARRIS CREEK.—McLennan County; rises near Coryell-McLennan county line; flows northward 8 miles into Tonk Creek (tributary through Middle Bosque, South Bosque, and Bosque rivers to the Brazos) 1 mile east of Crawford. Temple topographic map.

HARRIS CREEK.—Smith County; rises about 6 miles east of the town of Tyler; flows northeasterly 15 miles; empties into Sabine River about 5 miles northeast of Winona.

HARSLEYS CREEK.—Van Zandt County; small stream in southeastern part of county flowing easterly 6 miles into Neches River.

HARTS CREEK.—Titus County; rises about 3 miles north of Mount Pleasant in central part of county; flows southerly 11 miles into Big Cypress Bayou (tributary to Caddo Lake, thence to Red River, and thus to the Mississippi) in the southern part of the county.

HARVEY BAYOU.—San Augustine County; rises in southwestern part of county; flows southwesterly into Angelina River (tributary to Neches River); length, 6 miles.

HARVEY CREEK.—Fayette and Colorado counties; rises just north of Weimar in southeastern part of Fayette County; flows eastward 8 miles into Colorado River in western part of Colorado County.

HARVEY DRAW.—Garza County; rises in northwest corner of county; flows northeasterly 3 miles into Spring Creek (a tributary through North Fork of Double Mountain Fork of Brazos River to the Double Mountain Fork, thence to the Brazos) near Garza-Crosby county line.

HAW BRANCH.—Caldwell County; south of Dale; flows into Dry Creek (tributary to Plum Creek and thus through San Marcos River to the Guadalupe). San Marcos topographic map.

HAW BRANCH.—Fayette County; just north of Flatonia in the southwestern part of county; small intermittent tributary through Pinoak to Buckners Creek, and thus to Colorado River; length, 3 miles. Flatonia topographic map.

HAW BRANCH.—Hunt County; a small stream in northeastern part of county flowing into South Sulphur River (thence to Sulphur River and thus through Red River to the Mississippi).

HAY CREEK.—Coleman County; rises west of Trickham in the southeastern part of county; flows into Mukewater Creek and thus through Home Creek to Colorado River; length, 12 miles. Coleman and Brady topographic maps.

HAY HOLLOW.—Donley County; north central part; small stream flowing into Saddlers Creek, thence through Salt Fork of Red River to Prairie Dog Town Fork of Red River and thus through Red River to the Mississippi.

HAYS CREEK.—[illegible] County; [illegible] 7 miles into Prairie Creek, and thus through East Fork of [illegible] to Angelina River (tributary to Neches River) in southwestern part of county.

HAYRICK CANYON.—[illegible] County; rises near Hayrick Mountain; flows southward 7 miles into [illegible] Fork of Brazos River and thus to the Brazos.

HEATHS CREEK.—Brewster County; rises 15 miles north of Boquillas; flows in an easterly course 30 miles to its junction with Rio Grande 15 miles northeast of Boquillas; intermittent. Chisos Mountains topographic map.

H[illegible] CREEK.—Potter County; rises 7 miles northeast of Amarillo; flows northwesterly 15 miles into Amarillo Creek (tributary to Canadian River and thus through the Arkansas to Mississippi River) 1 mile above its mouth.

HEEL TOE CREEK.—Red River County; rises about 3 miles southeast of Clarksville; flows southwesterly 10 miles into [illegible] Creek (tributary to Cuthand Creek and thus through Sulphur and Red rivers to the Mississippi).

H[illegible] OR BA[illegible] CREEK.—Collin and Hunt counties; a head water stream of Sabine River; rises about 3 miles northeast of Farmersville; flows southeasterly 18 miles into Caddo Fork of Sabine River about 4 miles southwest of [illegible] in Hunt County.

HEMPHILL CREEK.—Hays and Caldwell counties; rises in the southeastern part of Hays County; flows southeast one mile through Hays County; then 6 miles through Caldwell County into Morrison Creek (tributary to San Marcos River and thus to the Guadalupe) one mile east of Martindale. San Marcos topographic map.

HE[illegible] CREEK.—Erath County; rises in northwestern part of county, 2 miles south of Lingleville; flows southwestward into [illegible] Creek (tributary to Armstrong Creek and thus to Leon River); partially intermittent. Stephenville topographic map.

HENRIETTA CREEK.—Wise and Tarrant counties; rises about 4 miles east of Newark in Wise County; flows northeasterly 6 miles into Elizabeth Creek (tributary through Denton Creek to Elm Fork of Trinity River and thus to the Trinity) about 3 miles east of Haslet. Fort Worth topographic map.

HENSON CREEK.—Coryell County; rises west of Henson Mountain in central part of county; flows northeasterly 6 miles into Leon River (tributary to Little River and thus to the Brazos) 3½ miles west of Leon Junction. Gatesville topographic map.

HENSHAW CREEK.—Erath County; flows northeasterly 3 miles to its junction with North Paluxy Creek (which discharges into Brazos River through Paluxy Creek) one mile west of Morgans Mill in northern part of county. Stephenville topographic map.

HERBERT CREEK.—Baylor County; rises in northern part of county; flows southeasterly 3½ miles into Wichita River (tributary to Red River and thus to the Mississippi).

HERMAN CREEK.—Mason County; a stream 9 miles long rising south of Bodeville in eastern part of county and flowing into Llano River (tributary to the Colorado). Mason topographic map.

HERRING BRANCH.—Montague County; a small intermittent stream flowing into Red River (tributary to the Mississippi) about 2 miles west of Valley School in northern part of county. Montague topographic map.

HERRON CREEK.—Bowie County; rises about 1½ miles southeast of Maud; flows southerly 2½ miles through Dixon, Big, and Maldon lakes to Sulphur River (tributary to Red River and thus to the Mississippi); intermittent. [illegible] Boston topographic map.

HICKMAN CREEK.—Newton County; flows easterly 5 miles into Sabine River in northeastern part of county.

HICKORY CREEK.—Blanco County; rises 3 miles north of Sandy in central part of county; flows southerly 8 miles into Pedernales River (tributary to the Colorado) 8 miles northwest of Johnson City. Blanco topographic map.

HICKORY CREEK.—Cooke County; rises about a mile north of Callisburg in northeastern part of county; flows northerly 10 miles into Red River (tributary to the Mississippi) about a mile west of Coesfield. Gainesville topographic map.

HICKORY CREEK.—Dallas County; rises 2 miles south of Mesquite in southeastern part of county; flows southerly 8 miles into Trinity River 4 miles south of Kleburg. Dallas topographic map.

HICKORY CREEK.—Denton County; rises in northwestern part of county; flows southeasterly 30 miles into Elm Fork of Trinity River (tributary to Trinity River) about 2 miles east of Lewisville.

HICKORY CREEK.—South Fork; Denton County; tributary to Hickory Creek (which discharges into Trinity River through Elm Fork of the Trinity) in west central part of county.

HICKORY CREEK.—Llano, Mason, and Gillespie counties; rises near the corner of Llano, Mason, and Gillespie counties; flows northeastward 20 miles into Llano River (tributary to the Colorado) 5 miles northwest of Sixmile. Llano topographic map.

HIGHHILL CREEK.—Fayette County; tributary to Colorado River in the eastern part of the county near La Grange; length, 4 miles.

HIGHLAND BAYOU.—Galveston County; rises in south central part of county; flows southeasterly 13 miles into West Galveston Bay and thus to Gulf of Mexico.

HILL CREEK.—Bosque and Somervell counties; formed 2 miles southwest of Eulogy by the union of the North and South forks of Hill Creek; flows northerly 4 miles into Brazos River 3½ miles west of Brazos Point in eastern part of Somervell County. Granbury topographic map.

HILL CREEK, SOUTH FORK.—Bosque County; rises near Somervell-Bosque county line, 2½ miles southwest of "Hill Creek;" flows northeasterly 7 miles to its junction with the North Fork of Hill Creek forming Hill Creek (tributary to Brazos River) 2 miles southwest of Eulogy. Granbury topographic map.

HILL CREEK, NORTH FORK.—Bosque County; rises 2 miles west of "Hill Creek;" flows easterly 6 miles to its junction with South Fork of Hill Creek forming Hill Creek (tributary to Brazos River) 2 miles southwest of Eulogy. Granbury topographic map.

HILL CREEK.—McMullen County; rises in northern part of county; flows northward 16 miles into Nueces River.

HILLS CREEK.—Burleson County; small stream flowing into Yegua Creek (tributary to Brazos River) north of Hicks in western part of county.

HILLEBRANT BAYOU.—Jefferson County; rises near Beaumont in northern part of county; flows southeasterly 18 miles into Taylors Bayou (thence though Sabine Lake to Gulf of Mexico) 3½ miles west of El Vista; tidal about 10 miles above mouth; takes a very irregular course through heavily timbered land in upper drainage basin; in lower reaches the channel is wide, deep, and open.

HINES BRANCH.—Caldwell County; rises south of Tilmon; an intermittent stream flowing through Plum Creek to the San Marcos and thus to Guadalupe River. San Marcos topographic map.

HISAW CREEK.—Runnels County; northeast of Maverick in western part of county; small intermittent stream 8 miles long flowing through Valley Creek into the Colorado. Hayrick topographic map.

HITSON BRANCH.—Stephens County; a westward flowing stream 3 miles long joining Gonzales Creek (tributary to Clear Fork of Brazos River and thus to the Brazos) 1½ miles southeast of Breckenridge. Breckinridge topographic map.

HITSON BRANCH.—Stephens County; a small stream rising 4 miles west of Caddo and flowing northerly 2 miles into Post Oak Branch (tributary through Little Cedar Creek to Big Cedar Creek and thus to Brazos River). Breckenridge topographic map.

HITSON CREEK.—Fisher and Stonewall counties; rises near Hitson in northeastern part of Fisher County; flows northerly 6 miles into Double Mountain Fork of Brazos River (which discharges into the Brazos) in southern part of Stonewall County. Roby topographic map.

HOG BAYOU.—Fort Bend County; a small stream about 1 mile long in southeastern part of county flowing southeasterly into Brazos River.

HOG BAYOU.—Panola County; rises about 3 miles northwest of Carthage; flows easterly 10 miles; empties into Sabine River a mile west of Pulaski.

HOG BRANCH.—Fayette County; northwest of Flatonia; small intermittent stream flowing into Big Fivemile Creek (tributary to Peach Creek and thus to Guadalupe River). Flatonia topographic map.

HOG BRANCH.—Stephens County; an intermittent stream rising near Double Mountain in southwestern part of county and flowing northwestward 8 miles into Sandy Creek (tributary to Hubbard Creek, thence through Gonzales Creek to Clear Fork of Brazos and Brazos rivers) near Buck Mountains. Breckenridge topographic map.

HOG CREEK.—Brown County; rises in the Hog Mountains 3 miles southeast of May in the northeastern part of the county; flows southwestward 12 miles into Pecan Bayou (tributary to Colorado River) 4 miles southeast of Byrd's store. Coleman and Brownwood topographic maps.

HOG CREEK.—Comanche and Eastland counties; rises 4 miles northeast of Desdemona in eastern part of Eastland County; flows southwestward 8 miles into Leon River (tributary through Little River to the Brazos) 3½ miles southwest of Desdemona in northern part of Comanche County. Eastland topographic map.

HOG CREEK.—Concho County; rises south of Paint Rock in northeastern part of county; flows 12 miles into Concho River (tributary to the Colorado). Ballinger and Eden topographic maps.

HOG CREEK.—Ellis County; small stream flowing through southwestern part of county into Mill Creek, thence through Pecan to Richland Creek and Trinity River.

HOG CREEK.—Erath County; an intermittent stream flowing northeasterly 3 miles into Little Green Creek (tributary to Green Creek, and thus through Bosque River to the Brazos) south of Alexander. Stephenville topographic map.

HOG CREEK.—Grayson County; a small intermittent stream flowing into Range Creek (tributary to Isle du Bois Creek, thence through Elm Fork of the Trinity to Trinity River) about 2 miles west of Ethel. Denison topographic map.

HOG CREEK.—Jasper County; a small intermittent stream flowing into Angelina River (tributary to Neches River) in northern part of county.

HOG CREEK.—McLennan, Bosque, and Coryell counties; rises near eastern corner of Hamilton County; flows southeasterly 36 miles into South Bosque River (tributary through Bosque River to the Brazos) 7 miles southwest of Waco in central part of McLennan County. Meridian and Waco topographic maps.

HOG CREEK.—Milam and Falls counties; rises near Lott in western part of Falls County; flows southeasterly 17 miles into Pond Creek (tributary to Brazos River) in northern part of Milam County.

HOG CREEK.—Runnels County; an intermittent stream west of Maverick in the western part of county; flows into Colorado River; length, 9 miles. Hayrick topographic map.

HOG CREEK.—Runnels County; flows through the town of Norwood in the southeastern part of the county; joins Mustang Creek (tributary to the Colorado); length, 6 miles. Ballinger topographic map.

HOG CREEK.—Shackelford County; a small stream flowing northwestward 5 miles into Clear Fork of Brazos River (which discharges into the Brazos) 10 miles north of Rising Sun in western part of county. Anson topographic map.

HOG MARSH.—Tom Green County; an intermittent stream flowing through the eastern part of the county into Lipan Creek and thus through the Concho into Colorado River; length, 17 miles. San Angelo topographic map.

HOLLAND CREEK.—Grimes County; rises north of Anderson; flows southwesterly into Navasota River (tributary to the Brazos) 3 miles north of the town of Navasota. Navasota topographic map.

HOLLIDAY CREEK.—Archer and Wichita counties; rises in northern part of Archer County; flows northeasterly 23 miles into Wichita River (tributary to Red River and thus to the Mississippi) in the southeastern part of Wichita County about 2 miles northeast of Wichita Falls.

HOLLIDAY CREEK.—Kendall County; a small stream rising southeast of Comfort and flowing into Guadalupe River.

HOLLINGS BRANCH.—Dallas and Tarrant counties; small stream flowing into Mountain Creek (tributary to West Fork of Trinity River and thus to the Trinity) southwest of Cedar Hill in southwestern corner of Dallas County and southeastern corner of Tarrant County. Fort Worth and Dallas topographic maps.

HOLLY CREEK.—Wood County; flows southerly 4 miles into Big Sandy Creek (tributary to Sabine River) in eastern part of county.

HOME CREEK.—Coleman County; rises 4 miles south of Glen Cove in western part of county; flows southeastward 30 miles into Colorado River 9 miles south of Trickham in the southeastern corner of the county. Ballinger, Coleman, and Brady topographic maps.

HOME CREEK.—Potter County; rises in north central part of county; flows southeasterly 7 miles into Canadian River (tributary to Arkansas River and thus to the Mississippi).

HONEY CREEK.—Burnet County; connects with Hamilton Creek (tributary to the Colorado) 4 miles northeast of Fairland in the south central part of the county; length, 5 miles. Burnet topographic map.

HONEY CREEK.—Comal County; small stream southwest of Spring Branch in northwestern part of county; flows into Guadalupe River; intermittent.

HONEY CREEK.—Collin County; rises about 3 miles northeast of Roseland; flows southeasterly 13 miles into East Fork of Trinity River (tributary to Trinity River) about 3 miles north of McKinney.

HONEY CREEK.—Coryell County; rises at Purmela in northwestern part of county; flows easterly 5 miles into Mustang Creek (tributary through Leon River to Little River and thus to the Brazos). Gatesville topographic map.

HONEY CREEK.—Hamilton County; rises 2 miles west of Carleton; flows northeasterly 15 miles into Bosque River (tributary to the Brazos) 3 miles east of Hico in northeast corner of county. Hamilton and Meridian topographic maps.

HONEY CREEK.—Hunt County; rises about 4 miles south of Wolfe City in northern part of county; flows southeasterly 6 miles into South Sulphur River (tributary to Sulphur River and thus through Red River to the Mississippi).

HONEY CREEK.—Lavaca County; rises near Lavaca-Colorado county line; flows southwesterly 4 miles into Navidad River (tributary to Lavaca River and thence to Gulf of Mexico through Matagorda Bay) 2 miles northwest of Sublime.

HONEY CREEK.—Lamar County; rises about 4 miles southeast of Brookston in southern part of county; flows southeastward 8 miles into North Sulphur River (tributary to Sulphur River, which discharges into the Mississippi through Red River) in the southern part of the county at the southern boundary line.

HONEY CREEK.—Kerr County; small stream flowing into North Fork of Guadalupe River (tributary to the Guadalupe) northwest of Japonica in central part of county. Kerrville topographic map.

HONEY CREEK.—Llano County; rises near Pyramid Rock, 8 miles south of the town of Llano in the southern part of the county; flows eastward 12 miles into Llano River (tributary to the Colorado) 3 miles west of Kingsland. Llano and Burnet topographic maps.

HONEY CREEK.—Mason County; a tributary, through Llano River to the Colorado, flowing west of Mason through the central part of county; length, 14 miles. Mason topographic map.

HONEY CREEK.—Palo Pinto County; a small stream flowing southeasterly 8 miles into Palo Pinto Creek (tributary to Brazos River) 1 mile northwest of Coalville, in southwestern part of county. Palo Pinto topographic map.

HONEY GROVE CREEK.—Fannin County; rises 2 miles north of the town of Honey Grove in eastern part of county; flows northwesterly 8 miles into Bois d'arc Creek (tributary to Red River and thus to the Mississippi).

HONDO CREEK.—Bandera, Medina, and Frio counties; rises in the central part of Bandera County; flows southward and southeastward 10 miles through Bandera County, 40 miles through Medina County, thence 13 miles through Frio County into Frio River (tributary to Nueces River) southwest of Pearsall.

HONDO CREEK.—Bexar County; small stream north of Elmendorf in the southeastern part of the county; flows into Calaveras Creek (tributary to the Guadalupe through San Antonio River). San Antonio topographic map.

HONDO CREEK.—Karnes County; northeast of Green in the southern part of the county; flows into San Antonio River and thus to the Guadalupe.

HONDO CREEK.—Llano County; rises north of Oxford in southern part of county; flows southeastward 6 miles to its junction with Sandy Creek (tributary to the Colorado) 2 miles west of Potato Hill. Llano topographic map.

HOOPER CREEK.—Shelby County; rises in southwestern part of county; flows southwesterly 11 miles into Attoyac Bayou (tributary to Angelina River and thus to the Neches) near Grigsby.

HOPES CREEK.—Brazos County; rises 2 miles north of Welburn; flows southwestward 4 miles into Brazos River in southern part of county.

HORD CREEK.—Goliad County; rises in southwestern part of county; flows into San Antonio River and thus to the Guadalupe; very small.

HORDS CREEK.—Coleman County; rises 5 miles northwest of Glen Cove in the western part of county; flows easterly 35 miles through Coleman into Jim Ned Creek (tributary to Pecan Bayou and thus to the Colorado) a mile southwest of Camp Colorado in the central part of the county. Ballinger and Coleman topographic maps.

HORDS CREEK.—(North); Coleman County; rises north of the town of Coleman in north central part of county; flows 11 miles to its junction with Hords Creek and thus to Jim Ned Creek (tributary through Pecan Bayou to Colorado River). Ballinger and Coleman topographic maps.

HORNE BRANCH.—Hill County; rises 2 miles northeast of Woodbury in central part of county; flows southwestward 4 miles into Aquilla Creek (tributary to Brazos River). Cleburne topographic map.

HORNICA CREEK.—Motley County; small stream rising in northern part of county and flowing northeasterly into Pease River (tributary to Red River and thus to the Mississippi); length, 8 miles.

HORSE CREEK.—Brewster County; rises in eastern part about 9 miles northeast of Bullis Gap; flows southeasterly 7 miles into Maxon Creek tributary to San Francisco Creek, and thus to Rio Grande; intermittent. Bullis Gap and Indian Wells topographic maps.

HORSE CREEK.—Coleman County; a stream 6 miles long south of Santa Anna in the central part of the county; flows into Home Creek and thus to the Colorado. Coleman topographic map.

HORSE CREEK.—Donley County; a stream 3 miles long flowing southerly through east central part of county into Salt Fork of Red River, thence to Prairie Dog Town Fork of the Red and thus through Red River to the Mississippi.

HORSE CREEK.—Hemhill County; an intermittent stream 6 miles long flowing southerly into Canadian River (which discharges into the Mississippi through the Arkansas) 5 miles northwest of Canadian in northwestern part of county.

HORSE CREEK.—Hunt County; rises in north central part of county; flows southerly 9 miles into Cowleach Fork of Sabine River thence to Sabine River through Caddo Fork of the Sabine, about a mile east of Greenville.

HORSE CREEK.—Titus and Morris counties; rises in the northeastern part of Titus County; flows northeasterly 7 miles into Whiteoak Bayou (tributary to Sulphur River and thus to the Mississippi through Red River) in the northwestern part of Morris County.

HORSE CREEK.—San Saba County; small stream rising 9 miles north of San Saba in the northeastern part of the county; flows 5 miles into Colorado River. San Saba topographic map.

HORSE HOLLOW.—Fisher County; rises in southeastern part of county; flows into Sweetwater Creek (tributary to Clear Fork of Brazos River and thus to the Brazos); intermittent. Roby topographic map.

HORSE PEN CREEK.—Harris County; rises 3 miles south of Houston Hot Wells; flows southeasterly 5½ miles into Langhams Creek (tributary through Bear and Mayde Creeks to Buffalo Bayou and thus through Sabine, Trinity, and Galveston bays to Gulf of Mexico); intermittent. Cypress, Hillendahl, and Addicks topographic maps.

HORSE PEN BAYOU.—Harris County; rises 2 miles east of Olcott; flows easterly 5 miles into Middle Bayou and thus to Galveston Bay and Gulf of Mexico; partially intermittent. Genoa and Seabrook topographic maps.

Horse Pen Creek.—Tyler County; small stream southwest of Woodville in western part of county; joins Wood Creek (tributary to Alabama Creek and thus to Neches River) southwest of Warren.

Horse Thief Canyon.—Jeff Davis County; an intermittent stream; heads 6 miles east of Fort Davis in eastern part of the county; flows northeasterly 20 miles into Limpia Creek (tributary to Paisano Creek and thus through Pecos River to Rio Grande). Fort Davis topographic map.

Hot Spring Creek.—Presidio County; heads 10 miles northeast of Ruidosa in Tierra Vieja Mountains; flows southwestward into Rio Grande 4 miles north of Ruidosa; length, 11 miles; intermittent. San Carlos topographic map.

House Creek.—Coryell County; rises at Coperas Cove in southern part of County; flows northeasterly 10 miles to a point 7 miles northwest of Killeen, where it enters Cowhouse Creek, and thus to Leon, Little, and Brazos rivers. Gatesville topographic map.

House Mountain Branch.—Llano County; an intermittent stream 3 miles in length flowing into Hickory Creek (tributary to Llano River and thus to the Colorado) east of Starkes in the southwestern part of county. Llano topographic map.

Housing Bayou.—Sabine County; rises in western part of county; flows easterly 22 miles across the south central part of county into Sabine River.

Houston Creek.—Ellis County; joins Pecan Creek (tributary to Trinity River through Richland Creek) in southwestern part of county.

Howard Creek.—Bowie County; rises about 1 mile south of Nash in eastern part of county; flows southeasterly 6 miles into Hurricane Creek (tributary to Sulphur River and thus through Red River to the Mississippi) about 3 miles south of Texarkana. Texarkana topographic map.

Howards Creek.—Reagan. Crockett, and Val Verde counties; rises near county line of Crockett and Reagan counties about 30 miles north of the town of Ozona; flows in a southerly course to Ozona then southwesterly 45 miles into Pecos River (tributary to Rio Grande) 25 miles northwest of Langtry in extreme northwestern part of Val Verde County.

Huana Creek.—Shelby County; formed about 2 miles southwest of Center by the union of the North and South branches; flows southeasterly 4 miles into South Tancha Bayou (tributary to Tancha Bayou and thus to Sabine River) about 4 miles west of Shelbyville.

Huana Creek, North Fork.—Shelby County; rises about 11 miles northwest of Center; flows southeasterly 11 miles to its confluence with South Fork of Huana Creek forming Huana Creek (tributary to South Tancha Bayou, thus to Tancha Bayou and Sabine River), 2 miles southwest of Center.

Huana Creek, South Fork.—Shelby County; rises in southern part of county; flows northerly to its junction with North Fork of Huana Creek, forming Huana Creek, thence to South Tancha Bayou, Tancha Bayou, and Sabine River.

Hubbard Creek.—Stephens, Shackelford, and Callahan counties; rises at Baird in northern part of Callahan County; flows northeasterly 60 miles into Gonzales Creek (tributary to Clear Fork of Brazos River, and thus to the Brazos) 1 mile southeast of Crystal Falls. Albany and Breckenridge topographic maps.

Hubbard Creek.—West Fork of; Callahan County; rises near Admiral; flows northerly 12 miles into Deep Creek (tributary through Hubbard Creek to Gonzales Creek, thence through Clear Fork of Brazos River to the Brazos) 6 miles northwest of Bremen in northeastern part of county.

HUCKLEBERRY CREEK.—Hansford County; rises in northern part of county; flows northeasterly into Beaver River (tributary to North Fork of Canadian River and thus through Canadian and Arkansas rivers to the Mississippi) in southeastern part of Texas County, Okla.

HUCKLEBERRY CREEK.—Newton County; rises 3 miles north of Newton; flows southeasterly 8 miles; enters Caney Creek (tributary to Sabine River) about 6 miles southeast of Newton.

HUDSON BRANCH.—McCulloch County; a small stream flowing 4 miles to its junction with San Saba River (tributary to the Colorado) near camp San Saba in the southern part of the county. Brady and Mason topographic maps.

HUEBNER CREEK.—Bexar County; rises northwest of San Antonio; flows into Leon Creek (tributary to Medina River, and thus through San Antonio River to the Guadalupe); intermittent. San Antonio topographic map.

HUFFSTEADER CREEK.—Stephens and Young counties; a stream 6 miles long flowing southerly to its junction with Clear Fork of Brazos River (tributary to Brazos River) 2 miles southeast of southwest corner of Young County. Breckenridge topographic map.

HUGHES CREEK.—Cass County; rises 1 mile north of Hughes Springs in southwestern part of county; flows southeasterly 10 miles into Black Cypress Bayou (tributary through Big Cypress Bayou to Ferry Lake, thence to Caddo Lake and thus through Red River to the Mississippi) 4 miles northeast of Avinger.

HUNTING BAYOU.—Harris County; rises in the northern part of the city of Houston; flows easterly and southeasterly 12 miles into Ship Channel (Buffalo Bayou) thence to Galveston Bay and Gulf of Mexico, 2 miles northeast of Pasadena. Settegast, Fauna, and Deepwater topographic maps.

HUNTER BRANCH.—Cooke County; small stream flowing into Clear Creek (tributary to Elm Fork of Trinity River and thus to the Trinity) in southwestern part of county; intermittent. Gainesville topographic map.

HUNTS BRANCH.—Bastrop County; north of Smithville in the southeastern part of county; a small intermittent tributary to Colorado River; length, 5 miles. Bastrop topographic map.

HURRICANE BAYOU.—Houston County; rises about 7 miles east of Crockett; flows westerly 19 miles into Trinity River southeast of Malvern.

HURRICANE CREEK.—Anderson County; rises about 6 miles north of Palestine; flows southeasterly 15 miles into Neches River.

HURRICANE OR DAY CREEK.—Bowie County, Tex., and Miller County, Ark.; formed about 1½ miles south of Texarkana in eastern part of Bowie County, Tex., by union of Harris and Ward creeks; flows southeasterly 3 miles to its intersection of the Texas-Arkansas State line, thence 9 miles to its confluence with Sulphur River (tributary to Red River and thus to the Mississippi) in Miller County, Ark. Texarkana topographic map.

HURRICANE CREEK.—Cass County; rises about ½ mile southeast of Queen City in northeastern part of county; flows southward 7 miles into Black Bayou (tributary to Caddo Lake and thus through Red River to the Mississippi) near Arnold's sawmill, 4 miles northeast of Bivins.

HURRICANE CREEK.—Sabine County; small stream flowing into Housing Bayou, thence to Sabine Riber about 4 miles south of Hemphill.

HURST CREEK.—Travis County; small intermittent stream north of Bee Caves in the northwestern part of the county flowing into Colorado River; length, 5 miles. Austin topographic map.

IMPERIALSIT CREEK.—Kinney and Maverick counties; rises 6 miles south of Brackett; flows southerly about 26 miles into Rio Grande. Brackett topographic map.

INDEPENDENCE CREEK.—Terrell County; rises 18 miles southwest of Sheffield; takes a general southeasterly course about 18 miles; empties into Pecos River (tributary to Rio Grande) 15 miles south of Old Fort Lancaster and Sheffield; intermittent.

INDIAN CREEK.—Bexar County; an intermittent stream flowing southwest of the City of San Antonio and south of the town of Leon into Leon Creek. and thus through Medina and San Antonio rivers to the Guadalupe. San Antonio topographic map.

INDIAN CREEK.—Brown County; small stream in the southern part of the county west of the town of Indian Creek; flows into Colorado River; length, 10 miles. Coleman, Brownwood, and San Saba topographic maps.

INDIAN CREEK.—Coleman County; rises northeast of the town of Coleman; flows through the northwestern part of the county into Jim Ned Creek and thus to Pecan Bayou (tributary to Colorado River); length, 6 miles. Coleman topographic map.

INDIAN CREEK.—Comanche County; rises 2 miles northeast of Logan Gap in southern part of county; flows easterly 19 miles into Leon River (tributary through Little River to the Brazos) 2 miles northeast of Dingler; passes through Comanche. Brownwood and Hamilton topographic maps.

INDIAN CREEK.—Comal County; small stream in western part of county; flows into Rio Cibolo (tributary to San Antonio River and thus to the Guadalupe).

INDIAN CREEK.—Cooke County; rises about 6 miles east of Gainesville; flows southerly 18 miles into Isle du Bois Creek (tributary to Elm Fork of the Trinity, then to the Trinity). Gainesville topographic map.

INDIAN CREEK.—Collingsworth County; rises in central part; flows northerly 4 miles into Salt Fork of Red River (tributary to Prairie Dog Town Fork of Red River and thus through the Red to the Mississippi).

INDIAN CREEK.—Denton County; tributary to Elm Fork of Trinity River (which discharges into Trinity River) in southwestern part of county.

INDIAN CREEK.—Donley and Hall counties; rises in southeastern part of Donley County; flows southeasterly 24 miles into Prairie Dog Town Fork of Red River (tributary to Red River and thus to the Mississippi) about 10 miles southwest of Salisbury in Hall County.

INDIAN CREEK.—Edwards County; an intermittent tributary; rises in the central part of the county; flows in southwesterly course to its junction with West Nueces River (tributary to Nueces River) about 2 miles below Ellis; length, 18 miles. Nueces topographic map.

INDIAN CREEK.—Erath County; rises at Bunkerhill; flows southerly 6 miles into Bosque River (tributary to Brazos River) 3 miles southwest of Selden in southern part of county. Stephenville topographic map.

INDIAN CREEK.—Fannin and Collin counties; rises near southwestern corner of Fannin County; flows southerly 7 miles into Bear Creek (tributary to Pilot Grove and thus through Sister Grove Creek to East Fork of Trinity River, then to the Trinity) about 3 miles east of Blue Ridge in Collin County.

INDIAN CREEK.—Gillespie County; in the southwestern part of the county; flows 4 miles into Scott Branch (tributary through Pedernales River to the Colorado). Kerrville topographic map.

INDIAN CREEK.—Grimes and Montgomery counties; rises in eastern part of Grimes County; flows southeasterly 3 miles through Grimes County, then 3 miles through Montgomery County into Lake Creek (tributary to West San Jacinto River), thence through San Jacinto River to the Gulf of Mexico.

INDIAN CREEK.—Jasper County; rises about 4 miles northwest of Jasper; flows westerly 9 miles into Angelina River (tributary to Neches River).

INDIAN CREEK.—Lavaca County; small stream rising east of Shiner and flowing southeasterly 4 miles into Rocky Creek (tributary to Lavaca River, thence to Matagorda Bay and Gulf of Mexico).

INDIAN CREEK.—Montgomery County; small tributary to Caney Creek (thence to Gulf of Mexico through East San Jacinto River and the San Jacinto) in northeastern part of county.

INDIAN CREEK.—Nacogdoches County; rises about 2 miles southeast of Socul in northwestern part of county; flows westerly 4 miles, joins Angelina River (tributary to Neches River) about one-half mile south of the Texas and New Orleans Railway crossing.

INDIAN CREEK.—Newton County; flows northerly 4 miles; empties into Buck Creek (tributary to Sabine River) a short distance above its mouth in northern part of county.

INDIAN CREEK.—Potter County; a stream 4½ miles long rising in northwestern part of county and flowing southerly into Canadian River (which discharges into the Mississippi through Arkansas River) 2 miles north of Amy.

INDIAN CREEK.—Shackelford County; rises 5 miles south of Albany; flows easterly 7 miles into Hubbard Creek (tributary to Gonzales Creek, thence through Clear Fork of Brazos River to the Brazos) south of McCatherine Mountain. Albany topographic map.

INDIAN CREEK.—Smith County; small stream 6 miles long flowing southwesterly into Neches River southwest of Tyler in the western part of county.

INDIAN CREEK.—Terrell County; rises in southwestern part, 1½ miles southwest of Taylor Ranch; flows southeasterly into Rio Grande; intermittent. Dryden Crossing topographic map.

INDIAN CREEK.—Uvalde County; an intermittent tributary in the "Canyon Country" north of Uvalde, about 5 miles east of Montell in western part of county; flows southerly 20 miles to its junction with Nueces River 2 miles below confluence of East and West Nueces rivers about 3 miles north of Hacienda. Uvalde topographic map.

INDIAN CREEK.—Wise and Tarrant counties; tributary to West Fork of Trinity River (which discharges into the Trinity) in the southeastern part of Wise and northwestern part of Tarrant counties. Fort Worth topographic map.

INDIAN CREEK.—Wood County; flows southerly 5 miles into Big Sandy Creek (tributary to Sabine River) in northeastern part of county.

INDIAN CAMP CREEK.—Erath County; rises 4 miles northeast of Stephenville; flows easterly 5 miles into Richardson Creek (tributary to Paluxy Creek and thus to Brazos River) near Sisk. Stephenville topographic map.

INGRANDO MARSH.—Harris County; 4½ miles southwest of Crosby in eastern part of county; drains easterly through Spring Gully and Granite Creek into San Jacinto River and thus to Gulf of Mexico. Harmaston topographic map.

IONI CREEK.—Anderson County; a stream flowing northeasterly into Neches River in the southeastern part of county; length, 13 miles.

IONI CREEK.—Palo Pinto County; rises near Stephens-Palo Pinto county line; flows northeasterly 23 miles into Brazos River 2 miles northwest of Wolf Mountain and 7 miles northwest of Palo Pinto in northwestern part of county. Breckenridge and Palo Pinto topographic maps.

IRISH CREEK.—De Witt County; small stream flowing into Guadalupe River 6½ miles southeast of Cuero in southeastern part of county.

IRON CREEK.—Hill County; a small intermittent stream rising 2 miles north of Prairie Valley; and flowing 4 miles into Brazos River in southern part of county. Waco topographic map.

IRON ORE CREEK.—Grayson County; rises about 6 miles northwest of Sherman in northern part of county; flows easterly 12 miles into Choctaw Creek (tributary to Red River and thus to the Mississippi) about 5 miles southeast of Denison. Denison topographic map.

IRON ROCK CREEK.—Blanco County; west of Westbrook in western part of county; small stream flowing into Pedernales River (tributary to Colorado River); length, 3 miles. Fredericksburg topographic map.

IRONS BAYOU.—Panola County; rises about 3 miles north of Clayton; flows northeasterly 14 miles into Sabine River 5 miles north of Carthage.

IRONS OR SPRING CREEK.—Waller County; rises 8 miles south of Hempstead; flows southerly 18 miles into Brazos River 6 miles east of Sealey in southwestern part of county.

IRWIN CREEK.—Throckmorton County; small stream flowing southwesterly 6 miles into Clear Fork of Brazos River (tributary to the Brazos) near Shackelford-Throckmorton county line 2 miles north of Fort Griffin. Albany topographic map.

ISINGLASS CANYON.—Terrell County; rises in southwestern part; flows southerly about 9 miles into Washboard Canyon (tributary to San Francisco Creek and thus to Rio Grande); intermittent. Indian Wells topographic map.

ISLAND CREEK.—Hill and Ellis counties; rises 3 miles northeast of Itasca, in northern part of Hill County; flows northeasterly 11 miles into North Fork of Pecan Creek (tributary to Pecan and Richland creeks, thence to Trinity River) in southern part of Ellis County. Cleburne topographic map.

ISLE DU BOIS CREEK.—Grayson, Cooke, and Denton counties; formed about 3 miles south of Collinsville, Grayson County, by the union of Range and Jordan creeks; flows southwesterly 14 miles into Elm Fork of Trinity River (tributary to the Trinity) about 5 miles northwest of Aubrey in Denton County. Denison topographic map.

IVANHOE CREEK.—Lipscomb County; an intermittent stream rising in northeastern part of county; flowing southeasterly into Oklahoma, joining Wolf Creek (tributary through North Fork of the Canadian to Canadian River, and thus through Arkansas River to the Mississippi) 6 miles west of Shattock, Okla.

JABALINA CANYON.—Terrell County; rises in southwestern part, 2½ miles west of Loma Vista; flows southerly 5 miles into Rio Grande; intermittent. Dryden Crossing topographic map.

JACK BAYOU.—Angelina County; small stream flowing into Cedar Creek (tributary to Neches River) in southwestern part of county.

JACKS BRANCH.—Hill County; rises 2 miles east of Woodbury in central part of county; flows southerly 7 miles into Aquilla Creek (tributary to Brazos River) 2 miles north of Vaughan. Cleburne and Waco topographic maps.

JACK BRANCH.—Val Verde County; an intermittent stream 4 miles long flowing southwestward into Ricardo Creek (tributary to Devils River, which discharges into Rio Grande).

JACKS BRANCH.—Stephens County; rises in the southwest corner of Stephens County; flows northerly 7 miles into Battle Creek (tributary to Bear Creek, and thus through Sandy, Hubbard, and Gonzales creeks to Clear Fork of Brazos River and thus to the Brazos) 4 miles southwest of Mankins Mill. Albany topographic map.

JACKSON BRANCH.—Dickens and Motley counties; rises in northern part of Dickens County; flows northeasterly 3 miles into South Pease River (tributary through Middle Pease to Pease River and thus through Red River to the Mississippi) in Motley County about one-half mile north of the southern boundary of the county.

JACKSON BRANCH.—San Saba County; small intermittent stream just east of the town of Cherokee in southern part of county; flows northerly to its junction with Cherokee Creek (tributary to Colorado River) 2 miles north of the town of Cherokee. Llano and San Saba topographic maps.

JACKSONS BAYOU.—Harris County; rises one-half mile west of Crosby; flows easterly and southeasterly 4 miles through Crosby into San Jacinto River and thus to Gulf of Mexico; partially intermittent. Crosby topographic map.

JACKSON BRANCH.—Throckmorton County; rises near southern Shackelford county line; flows northeasterly 3 miles into Clear Fork of Brazos River (tributary to the Brazos) 3 miles northwest of Fort Griffin. Albany topographic map.

JACKSON CREEK.—Fayette County; east of Roundtop in northern part of county; tributary through Cummins Creek to Colorado River; length, 7 miles.

JACKSON CREEK.—Panola County; formed in the northwestern part of the county by the union of Rogers and Tuttle creeks; flows southwesterly about 6 miles into Sabine River.

JACKSON CREEK.—Washington County; rises 8 miles northeast of Gay Hill; flows southeasterly 13 miles into Brazos River about 5 miles north of Houston & Texas Central Railroad crossing.

JACKSON LAKE.—Falls County; 5 miles northeast of Chilton, just west of Brazos River in northern part of county; length, about 2 miles; maximum width, one-half mile. Temple topographic map.

JACK JOHN CREEK.—Fayette County; 3½ miles northeast of Muldoon in the central part of the county; intermittent tributary through Buckners Creek to Colorado River; length, 5 miles. Flatona topographic map.

JACOBS BRANCH.—Hood County; rises in northern part of county 1½ miles southwest of Center Mill; flows westerly 1½ miles into Brazos River. Weatherford topographic map.

JACOBS CREEK.—Comal County; near Hancock in northeastern part of county; small intermittent stream flowing into Guadalupe River.

J. HALL CREEK.—Motley County; rises about 4 miles northeast of Lyman in western part of county; flows northeasterly 3 miles into Cottonwood Mott Creek (tributary through Middle Pease River to Pease River and thus through Red River to the Mississippi).

JAHUEY CREEK.—Zavalla, Frio, and Lasalle counties; rises 5 miles southeast of Loma Vista in the southeastern part of Zavalla County; flows southeasterly 5 miles through Frio County, then 28 miles through Lasalle County into Frio River (tributary to the Nueces) 5 miles northeast of Dull; length, 38 miles.

JAKES CREEK.—Red River County; rises about 5½ miles northeast of Clarksville; flows southerly 5½ miles into Gragg Creek (tributary to Kickapoo Creek, thence to Cuthand Creek and thus through Sulphur and Red rivers to the Mississippi).

JAMES RIVER.—Kimble and Mason counties; rises south of Noxville in the southeastern part of Kimble County; flows northeasterly 15 miles through Kimble County, then 22 miles through Mason County to its junction with Llano River (tributary to the Colorado) 7 miles south of Mason in the central part of Mason County; south of a point near the Mason-Kimble county line the river forks, forming what is known as East and West Fork of James River. Kerrville and Mason topographic maps.

JANE CREEK.—Dewitt County; small stream in southern part of county; flows into Coleto Creek and thus to the Guadalupe.

JARBO BAYOU.—Galveston County; a small tidal stream tributary to Clear Lake (thence to Galveston Bay and Gulf of Mexico) in the northern part of the county.

JASPER OR HOG CREEK.—Wise and Jack counties; joins West Fork of Trinity River and thus to the Trinity in the southeastern part of Jack County and southwestern part of Wise County.

JENNINGS LAKE.—Cass County; about one-half mile north of Jennings Lake Switch in northwestern part of county; an "old channel lake" formed by former channel of Sulphur River; inlet, Fleming Creek; outlet, Sulphur River (tributary to Red River and thus to the Mississippi). Daingerfield topographic map.

JERRY CREEK.—Caldwell County; northeast of Lockhart in the northern part of the county; small intermittent stream; flows into Dry Creek and thus through Plum Creek and San Marcos River to the Guadalupe. San Marcos topographic map.

JESSE ARROYO.—Donley County; a stream 9 miles long flowing northeasterly through eastern part of county into Salt Fork of Red River (tributary to Prarie Dog Town Fork of Red River and thus through the Red to Mississippi River).

JIM BAYOU.—Cass and Marion counties; rises in southern part of Cass County about 1 mile west of Linden; flows southeasterly 24 miles into Caddo Lake (thence to Red River and thus to the Mississippi) in northeastern part of Marion County near the State boundary.

JIM JOHN CREEK.—San Saba County; a stream 2 miles long in the southeastern corner of county; tributary to Colorado River. Burnet topographic map.

JIM LITTLE CREEK.—Kimble County; a small stream in southeastern part of county; flows 10 miles joining James River and thus through the Llano to Colorado River.

JIM NAIL BRANCH.—Eastland County; flows southwesterly 4 miles to its junction with Leon River (which discharges into the Brazos through Little River) 6 miles southeast of Merriman in central part of county. Eastland topographic map.

JIM NED CREEK.—Taylor, Coleman, and Brown counties; rises 7½ miles southeast of Buffalo Gap in the southeastern part of Taylor County; flows southeasterly 20 miles through Taylor County, 34 miles through Coleman County, then 17 miles through Brown County into Pecan Bayou (tributary to Colorado River) 9 miles north of Brownwood in the central part of Brown County. Abilene and Coleman topographic maps.

JIMMYS CREEK.—Comanche County; small stream flowing northeasterly 8 miles into South Copperas Creek (tributary to Copperas Creek, thence through Leon River to Little River and thus to the Brazos) 5 miles south of Sipe Springs. Brownwood topographic map.

JOBS CREEK.—San Saba County; an intermittent tributary to San Saba River in the western part of county west of San Saba; lengh, 10 miles. San Saba topographic map.

JOE BEATTY CREEK.—Armstrong County; rises in southwestern part of county; flows northeasterly 2 miles into Prairie Dog Town Fork of Red River (tributary to Red River, which discharges into the Mississippi).

JOHN CREEK.—Potter County; a small stream flowing northwesterly through central part of county into Canadian River (tributary to Arkansas River and thus to the Mississippi); length, 4 miles.

JOHNS CREEK.—Cass County; rises about 4 miles east of Douglasville in northern part of county; flows southward 14 miles into Frazier Creek (tributary to Caddo Lake and thus through Red River to the Mississippi) about 7 miles east of Linden.

JOHNS CREEK.—Delta County; rises about 8 miles northwest of Cooper in western part of county; flows southeasterly 12 miles into South Sulphur River (tributary to Sulphur River, which discharges into the Mississippi through Red River) at the southern boundary of the county.

JOHNS CREEK.—Victoria County; small tributary in western part of county; flows through Cottonwood Creek into Coleto Creek and thus to the Guadalupe.

JOHNSON CREEK.—Kerr County; rises north of Mountain Home in northern part of county; flows southeasterly 19 miles into Guadalupe River at Ingram. Kerrville topographic map.

JOHNSON CREEK.—Llano County; rises 5 miles east of Field Creek in the northwestern part of the county; flows southeastward 15 miles into Llano River (tributary to Colorado River) 3 miles west of Llano. Llano topographic map.

JOHNSON CREEK.—Marion County; rises in western part of county; flows southerly 7 miles into Big Cypress Bayou, thence to Caddo Lake, and thus through Red River to the Mississippi.

JOHNSON CREEK.—Rusk and Cherokee counties; rises in northwestern part of Rusk County; flows southwesterly 19 miles into Striker Creek (tributary through Angelina River to the Neches) in southeastern part of Cherokee County.

JOHNSON CREEK.—Tarrant and Dallas counties; rises at Johnson station in eastern part of Tarrant County; flows northeasterly 9 miles into West Fork of Trinity River (tributary to the Trinity) 1½ miles northwest of Grand Prairie in the eastern part of Dallas County. Fort Worth topographic map.

JOHNSON CREEK.—Dewitt County; small stream in southwestern part of county; flows into Manahuilla Creek and thus through San Antonio River to the Guadalupe.

JOHNSONS CREEK.—Young County; small stream flowing eastward 3 miles into Brazos River 1 mile south of Bellknap in central part of county.

JOHNSONS LAKE.—Haskell County; 10 miles north of the village of Haskell in northern part of county; outlet, Lake Creek (tributary through Millers Creek to Brazos River).

JOHNSONS RUN.—Crockett and Val Verde counties; rises 10 miles north of the town of Ozona in central part of county; flows southerly 35 miles to the Val Verde County line, then southeasterly about 16 miles to Devils River (tributary to Rio Grande); intermittent.

JONAH CREEK.—Collingsworth, Hall, and Childress counties; rises in Collingsworth County about 2½ miles northeast of the southwestern corner of Collingsworth County; flows southeasterly 22 miles into Prairie Dog Town Fork of Red River (tributary through Red River to the Mississippi) in northwestern part of Childress County.

JONES CREEK.—Brazos County; rises in southern part; flows southeastward 4 miles into Navasota River (tributary to Brazos River) northeast of Millican. Navasota topographic map.

JONES CREEK.—Brazoria County; small stream flowing southerly in the southern part of the county into a small lake (unnamed) and thus to the Gulf of Mexico.

JONES CREEK.—Bowie County; a small intermittent stream rising about 4 miles southeast of Redwater, and flowing to Kelley Creek (tributary to Sulphur River, and thus through Red River to the Mississippi). Texarkana topographic map.

JONES CREEK.—Bowie County; rises about 2 miles southwest of Leary in eastern part of county; flows northerly into Big Creek, which discharges into the Mississippi through Red River. Texarkana topographic map.

JONES CREEK.—Hunt County; rises about 3 miles west of Wolfe City, near northern boundary of county; flows southeasterly 4 miles into South Sulphur River, thence to Sulphur River, which discharges into the Mississippi through Red River.

JONES CREEK.—Montague County; an intermittent stream flowing into Big Sandy Creek (tributary through West Fork of Trinity River to the Trinity) south of Bowie in the southwestern part of the county. Montague topographic map.

JONES CREEK.—Motley County; rises about 2 miles north of Lyman in western part of county; flows northeastward 4 miles into Cottonwood Mott Creek (tributary to Middle Pease River, and thus through Pease and Red rivers to the Mississippi).

JONES CREEK.—Wharton County; a small tributary to Colorado River south of Wharton in the southern part of the county; length, 20 miles.

JONES VALLEY.—Montague County; small area draining into Denton Creek (tributary to Elm Fork of Trinity River and thus to the Trinity) about 3 miles east of Denver. Montague topographic map.

JORDAN CREEK.—Grayson County; rises at Whitesboro; flows southerly 11 miles to its confluence with Range Creek, about 3 miles south of Collinsville, forming Isle du Bois Creek (tributary through Elm Fork of Trinity River to the Trinity). Denison topographic map.

JORDAN CREEK.—Kent County; rises near Kent-Dickens county line; flows southwesterly 4 miles into Duck Creek (tributary to Salt Fork of the Brazos, and thus to the Brazos) near Girard in northern part of county.

JORDAN GULLEY.—Harris County; rises one-third of a mile east of Humble; flows northeasterly 2½ miles through Moonshine Hill into San Jacinto River and thus to Gulf of Mexico; partially intermittent. Harmaston and Moonshine Hill topographic maps.

JORDAN CREEK.—Jasper County; small stream flowing into Indian Creek (tributary to Angelina and Neches rivers) in northwestern part of county.

JORDAN CREEK.—Washington County; rises 2½ miles south of Old Washington; flows northeasterly 3 miles into Brazos River in northeastern part of county. Navasota topographic map.

JOSHUA CREEK.—Kendall County; small stream in western part of county flowing southwest of Sisterdale into Guadalupe River.

JOSHUA CREEK, EAST FORK.—Kendall County; headwater stream of Joshua Creek (tributary to Guadalupe River) southwest of Sisterdale in western part of county.

JOSHUA CREEK, WEST FORK.—Kendall County; southwest of Sisterdale in western part of county; headwater stream joining East Fork of Joshua Creek to form Joshua Creek (tributary to Guadalupe River).

JOTENA CREEK.—Webb County; a small stream in southeastern part of county flowing northwestward 8 miles into Prieto Creek (tributary to the Nueces).

JOURNIGAN CREEK.—Delta County; rises near the intersection of Fannin, Hunt, and Delta county boundary line; flows southeasterly 11 miles into Middle Fork of Sulphur River (tributary to South Sulphur River and thus through Sulphur and Red rivers to the Mississippi).

JOURNIGAN CREEK, WEST FORK OF.—Fannin, Hunt, and Delta counties; rises in southeastern part of Fannin County; flows southeasterly 9 miles into Journigan Creek (tributary to Middle Fork of Sulphur River, thence through South Sulphur River to Sulphur River and thus through Red River to the Mississippi) in southwestern part of Delta County.

JUANITO CREEK.—Matagorda County; small tributary to Tres Palacios Creek (thence to Matagorda Bay and thus to Gulf of Mexico) in western part of the county; flows southeasterly 2 miles.

JUG CREEK.—Irion and Tom Green counties; small intermittent stream; rises in northeastern part of Irion County; flows southward joining Middle Concho River (tributary through South Concho and Concho Rivers to the Colorado) 4 miles southeast of Arden in the western part of Tom Green County. Sherwood topographic map.

KAOLIN CREEK.—Uvalde County; small intermittent tributary to Dry Frio River near Kelly ranch. Uvalde topographic map.

KARANKAWA BAYOU.—Galveston County; rises in the southwestern part of the county; flows southeasterly 3 miles into Karankawa Lake, West Galveston Bay, and thus to Gulf of Mexico.

KATE CREEK.—Borden and Howard counties; in the northern part of Howard and southern part of Borden County; flows into Colorado River; length, 10 miles.

KATEMCY CREEK.—Mason and McCulloch counties; rises 4 miles south of Katemcy in the northern part of Mason County; flows northward 11 miles into San Saba River (tributary to the Colorado) at Camp San Saba in the southeastern part of McCulloch County. Mason topographic map.

KEE BRANCH.—Tarrant County; a small stream flowing into Rush Creek (tributary to Village Creek, and thus through West Fork of Trinity River to the Trinity) north of Kennedale. Fort Worth topographic map.

KEECHEY OR KEECHI CREEK.—Anderson County; rises about 5 miles northwest of Palestine; flows southwesterly 12 miles into Trinity River about 3 miles west of Douglass.

KEECHI CREEK.—Leon County; rises about 1 mile northeast of Robbins; flows northeasterly, easterly, and southeasterly 29 miles into Trinity River at Cairo.

KEECHIE CREEK, EAST FORK.—Jack and Palo Pinto counties; rises in southern part of Jack County near Perrin; flows southwesterly into Keechie Creek (tributary to Brazos River) 1 mile northwest of Graford in northeastern part of Palo Pinto County. Palo Pinto topographic map.

KEECHIE CREEK.—Palo Pinto and Jack counties; rises 5 miles south of Jacksboro in southern part of Jack County; flows southerly 22 miles into Brazos River 5 miles south of Graford in northern part of Palo Pinto County. Palo Pinto topographic map.

KEENER CREEK.—Llano County; small intermittent stream flowing into Crabapple Creek (tributary to Sandy Creek and thus to Colorado River). Llano topographic map.

KELLOG CANYON.—Brewster County; heads in eastern part about 4½ miles southwest of Bullis Gap; flows northeasterly 12 miles through Bullis Gap and Cedar Gap into San Francisco Creek and thus to Rio Grande; intermittent. Bullis Gap topographic map.

KELSEY CREEK.—Upshur County; rises in the western part of county; flows eastward 13 miles to a point about 4 miles north of Gilmer, where it enters Little Cypress Creek, thence to Caddo Lake, and thus through Red River to the Mississippi.

KELLEY CREEK.—Bowie County; rises about 3½ miles south of Clem; flows easterly 5 miles into Sulphur River (tributary through Red River to the Mississippi) about 5 miles southeast of Redwater in southern part of county. New Boston and Texarkana topographic maps.

KELLEY CREEK.—Kerr County; tributary to Guadalupe River southeast of Japonica in the central part of the county. Kerrville topographic map.

KELLEY CREEK.—Morris and Cass counties; rises at Naples in northern part of Morris County; flows southeasterly 15 miles into Black Cypress Bayou (tributary to Big Cypress Bayou, which discharges into Caddo Lake and thus through Red River to the Mississippi) 6½ miles northeast of Hughes Springs in southwestern part of Cass County. Daingerfield topographic map.

KELLY CREEK.—Donley County; west central part; flows northeasterly 6 miles into Salt Fork of Red River (tributary to Prairie Dog Town Fork of Red River, which discharges into Mississippi River through the Red) about 4½ miles north of Clarendon.

KENO OR GOLD CREEK.—Dawson and Borden counties; rises south of Michies in the eastern part of Dawson County; flows easterly about 16 miles into Colorado River in the southwestern part of Borden County.

KERR CREEK.—Angelina County; a stream 4 miles in length flowing northwesterly into Angelina River (tributary to Neches River) in the northwestern part of county.

KERR CREEK.—Gonzales County; east of the town of Gonzales; small intermittent tributary to Guadalupe River. Flatonia topographic map.

KEYSER CREEK.—Mason County; an intermittent tributary to Llano River (thence to the Colorado) flowing southwest of Castell in the eastern part of the county; length, 7 miles. Mason and Llano topographic maps.

KICKAPOO CREEK.—Baylor and Archer counties; rises in southeastern part of Baylor County about 1 mile from Baylor-Archer county line; flows northeasterly 17 miles into North Fork of Little Wichita River (tributary through Little Wichita River to Red River and thus to the Mississippi) in western part of Archer County.

KICKAPOO CREEK.—Coke and Runnels counties; an intermittent stream flowing southerly 12 miles along Coke-Runnels county line; joins Colorado River 3½ miles west of Maverick in the western part of Runnels County. Hayrick topographic map.

KICKAPOO CREEK.—Edwards County; a small intermittent tributary in the southern part of county; unites with West Nueces River (thence to the Nueces) at Kickapoo Springs; flows southwesterly 4 miles. Nueces topographic map.

KICKAPOO CREEK.—Harris County; rises in northwestern part of county 2½ miles north of Waller; flows easterly 4½ miles into Spring Creek (tributary to San Jacinto River, thence to Galveston Bay and Gulf of Mexico); intermittent.

KICKAPOO CREEK.—Parker, Hood, and Palo Pinto counties; rises 4 miles west of Lipan in southern corner of Palo Pinto County; flows northerly 18 miles into Brazos River a mile southeast of Buckner, in southwestern corner of Parker County. Stephenville, Palo Pinto, and Weatherford topographic maps.

KICKAPOO CREEK.—Red River County; rises about 4 miles northeast of Annona in eastern part of county; flows southerly 12 miles into Cuthand Creek (tributary to Sulphur River and thus through Red River to the Mississippi) about 9 miles south of Annona in southern part of county.

KICKAPOO CREEK.—Schleicher, Tom Green, and Concho counties; rises in the northeastern corner of Schleicher County at an approximate altitude of 2,400 feet above sea level; flows northeastward 38 miles into Concho River (tributary to the Colorado) 2 miles west of Paint Rock in the northwestern part of Concho County; drainage, area, 310 square miles. San Angelo, Eden, and Ballinger topographic maps.

KICKAPOO CREEK.—Trinity and Polk counties; rises in the southeastern part of Trinity County; flows southerly and westerly 10 miles through Trinity County, then 16 miles through Polk County into Trinity River east of Pointblank.

KICKAPOO CREEK.—Van Zandt and Henderson counties; rises about 6 miles south of Canton in Van Zandt County; flows southeasterly 32 miles into Neches River in Henderson County about 6 miles southwest of Chandler.

KICKAPOO CREEK, WEST FORK, OR ALLIGATOR CREEK.—Van Zandt County; rises south of Canton in the southwestern part of the county; flows southwesterly 7 miles into Kickapoo Creek (tributary to Neches River).

KICKAPOO CREEK, EAST FORK.—Van Zandt and Henderson counties; rises southeast of Canton in southern part of Van Zandt County; flows southerly 11 miles into Kickapoo Creek (tributary to Neches River) near the Van Zandt and Henderson county line.

KILDOOGAN CREEK.—Fisher and Nolan counties; an intermittent stream 9 miles long flowing southeasterly into Sweetwater Creek (tributary through Clear Fork of Brazos River to the Brazos) 4 miles east of the village of Sweetwater in northern part of Nolan County. Roby topographic map.

KILFOIL DRAW.—Donley County; rises in southeastern part of county; flows northeastward 7½ miles into Lake Creek (tributary to Salt Fork of Red River and thus through Prairie Dog Town Fork of the Red and the Red to Mississippi River) about 2 miles southeast of Lelia.

KILGORE CREEK.—Goliad County; small stream northeast of Goliad in northeastern part of county; flows through Perdido Creek to Coleto Creek and thus to the Guadalupe.

KIMBLE CREEK.—Hunt County; rises about 2 miles south of Greenville; flows southerly 10 miles into Beane Creek, thence to Caddo Fork of Sabine River (tributary to the Sabine).

KING CREEK.—Mills County; a small stream 6 miles long east of Regency in the southwestern part of the county; flows into Colorado River. Brownwood and San Saba topographic maps.

KINCAID CREEK.—Brewster County; rises in northeastern part about 6 miles southwest of Gage ranch; flows easterly into Bear Creek tributary to Rio Grande; intermittent. Hood Spring and Dove Mountain topographic maps.

KINGS BRANCH.—Cass County; rises at Munz in northern part of county; flows northeasterly 3½ miles into Caney Creek (tributary to Sulphur River and thus through Red River to the Mississippi); intermittent. Linden topographic map.

Kings Creek.—Throckmorton and Shackelford counties; a stream flowing southeasterly 7 miles into Clear Fork of Brazos River (tributary to Brazos River) 1 mile north of the southeast corner of Throckmorton County. Albany and Breckenridge topographic maps.

Kings Fork of Cedar Creek.—Kaufman County; rises in northern part of county; flows southerly 20 miles into Cedar Creek (tributary to Trinity River) about 3 miles southwest of Kaufman.

Kiowa Creek.—Knox and Baylor counties; rises in northeastern part of Knox County; flows southeastward into South Wichita River (tributary through Wichita to Red River and thus to the Mississippi) in northwestern part of Baylor County.

Kirkendall Hollow.—Erath County; a small intermittent stream south of Dublin in southern part of county; flows southerly into Resley Creek (tributary to Leon River, and thus through Little River to the Brazos); length, 3 miles. Stephenville topographic map.

Kit Carson Creek.—Moore and Hutchinson counties; rises near the line of Moore and Hutchinson counties; flows southeasterly 17 miles into Canadian River (which discharges into the Mississippi through Arkansas River) 10 miles west of Plemons in western part of Hutchinson County; intermittent.

Klein Branch.—Gillespie County; small stream joining Pedernales River (tributary to the Colorado) 3 miles northeast of Harper in the southwestern part of the county; length, 4 miles. Kerrville topographic map.

Knights Branch.—Dallas County; small stream flowing into Trinity River northwest of Dallas. Dallas topographic map.

Knobbs Creek.—Lee and Fayette counties; tributary through Rabbs Creek to Colorado River, in the [illegible] part of Fayette County and the southern part of Lee County; length, 9 miles. Bastrop topographic map.

Knox Branch.—Shackelford and Throckmorton counties; a southwestward flowing stream joining Clear Fork of Brazos River (tributary to the Brazos) 1 mile north of Fort Griffin, in northern part of county; length, 2½ miles. Albany topographic map.

Kuykendalls Creek.—Washington County; rises 2 miles east of Gay Hill; flows southeasterly 10 miles into New Years Creek (tributary to Brazos River) 5 miles north of Chappel Hill.

Lacy Creek.—Titus County; rises in northeastern part; flows southeasterly 5 miles into Whiteoak Bayou (tributary to Sulphur River and thus through Red River to the Mississippi).

Lacys Fork of Cedar Creek.—Van Zandt and Kaufman counties; rises about 2 miles west of Canton in Van Zandt County; flows southwesterly 23 miles to a point near Gossett close to its intersection of south Kaufman County line, where it enters Cedar Creek (tributary to Trinity River).

Laguna Grande.—Dallam County; northeast of Corlena in northwestern part of county in Rabbit Ear Creek drainage.

Lagunillas Creek.—Atascosa and McMullen counties; rises in western part of Atascosa County; flows southeastward 20 miles through Atascosa County and 1 mile through McMullen County into San Miguel Creek (tributary to Frio and Nueces rivers); length, 21 miles.

Lake Creek.—Anderson County; small tributary to Trinity River is western part of county.

Lake Creek.—Collingsworth County; a stream 5 miles long rising in central part of county and flowing into Salt Fork of Red River (tributary to Prairie Dog Town Fork of the Red and thus through Red River to the Mississippi).

LAKE CREEK.—Delta County; a small stream in eastern part of county flowing southeasterly 9 miles into South Sulphur River, thence to Sulphur River and thus through Red River to the Mississippi.

LAKE CREEK.—Donley County; rises about 4 miles southeast of Clarendon; flows northeasterly 15 miles into Salt Fork of Red River (tributary to Prairie Dog Town Fork of Red River and thus through the Red to Mississippi River).

LAKE CREEK.—Grimes and Montgomery counties; rises in northeastern part of Grimes County; flows southeasterly 10 miles through Grimes County, then 33 miles through Montgomery County into West San Jacinto River (tributary to San Jacinto River and thus to Galveston Bay and Gulf of Mexico) south of Conroe.

LAKE CREEK.—Haskell, Baylor, and Knox counties; rises in northern part of Haskell County; flows northeasterly into Millers Creek (tributary to Brazos River) in southern part of Baylor County.

LAKE CREEK.—Palo Pinto County; rises 4 miles southwest of Metcalf Gap in southwestern part of county; flows easterly 15 miles into Palo Pinto Creek (tributary to Brazos River) 5 miles north of Coalville. Palo Pinto topographic map.

LAKE CREEK.—Williamson County; small stream joining Brushy Creek (tributary to San Gabriel River, thence through Little River to the Brazos) southeast of the village of Round Rock in southern part of county. Georgetown and Austin topographic maps.

LAKE ERIE CANYON CREEK.—Hall County; rises in central part; flows northward three miles into Little Red River (tributary to Prairie Dog Town Fork of the Red and thus through Red River to the Mississippi).

LAKE FORK OF SABINE RIVER.—See Sabine River, Lake Fork of.

LAKE HOLLOW.—Schleicher County; a small intermittent stream 4 miles long rising in the southeastern part of the county and flowing through North Valley into San Saba River (tributary to the Colorado). Fort McKavett topographic map.

LAKE JANE.—Fort Bend County; 5 miles northeast of Richmond in Oyster Bayou drainage (Brazos River drainage); very small.

LAKE LEOLA.—Donley County; about a mile northwest of Clarendon; when overflowing, tributary to Clarendon Lake (which discharges into Little Brushy Creek, thence to Salt Fork of Red River and thus through Prairie Dog Town Fork of Red River to Red and Mississippi rivers); small.

LAKE VALLEY CREEK.—Jack County; stream flowing through northwestern part of county into West Fork of Trinity River (tributary to the Trinity) south of the town of Antelope.

LAMBS CREEK.—Limestone and Freestone counties; rises in the southern corner of Freestone County; flows southwesterly 7 miles into Sanders Creek (which discharges into Brazos River through the Navasota) in the southeast corner of Limestone County.

LAMBS HEAD CREEK.—Throckmorton and Shackelford counties; rises 2 miles northeast of Antelope Hills, in northern part of Shackelford County; flows northeasterly 7 miles into Clear Fork of Brazos (tributary to the Brazos) 5 miles north of Fort Griffin in southern part of Throckmorton County. Albany topographic map.

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LAMPASAS RIVER.—Hamilton, Lampasas, Burnet, and Bell counties; rises about 4 miles north of McGirk, in western part of Hamilton County, at an approximate altitude of 1,600 feet above sea level; flows southeasterly 100 miles, uniting with Leon River 7 miles southeast of Belton in central part of Bell County to form Little River (tributary to the Brazos). Hamilton, Lampasas, Gatesville, Georgetown, Temple, and Taylor topographic maps.

LAMPTON CREEK.—Donley County; small stream in eastern part of county flowing into Red Mud Creek (tributary to McCormick Creek, thence to Salt Fork of Red River and thus through Prairie Dog Town Fork of the Red to Red and Mississippi rivers).

LANDERS BRANCH.—Cooke County; a small stream rising about 4 miles southeast of Marysville in northern part of county and flowing into South Fish Creek, thence to Fish Creek and thus through Red River to the Mississippi. Gainesville topographic map.

LANG CREEK.—Mason and Llano counties; a stream flowing south of Castell in the eastern part of Mason County, then through western Llano County into Llano (tributary to Colorado River); length, 6 miles. Llano topographic map.

LANGHAM CREEK.—Harris County; rises in western part of county 4½ miles southwest of Cypress; flows southeasterly 11 miles into Bear Creek (tributary to Mayde Creek, thus to Buffalo Bayou, thence through San Jacinto, Trinity, and Galveston bays, to Gulf of Mexico); intermittent. Cypress, Addicks, and Hillendahl topographic maps.

LANGUM OR BIG CREEK.—Bowie County; rises about one-half mile south of New Boston near center of county; flows southeasterly 21 miles into Sulphur River (tributary to Red River, which discharges into the Mississippi) about 6 miles southeast of Redwater; near its mouth it connects with Elliott Creek by overflow channel. New Boston and Texarkana topographic maps.

LA PARITA CREEK.—Atascosa County; rises near Charlotte in western part of county; flows southeasterly 30 miles into Atascosa River (tributary to the Nueces through Frio River) about 3 miles northwest of Whitsett.

LARRISON CREEK.—Cherokee County; rises in southeastern part of county; flows southerly into Neches River in southeastern part of county; length, 15 miles.

LARRISONS CREEK.—Madison County; rises in northern part of county; flows southeasterly 20 miles into Bidais Creek (tributary to Trinity River).

LAS MORAS CREEK.—Kinney and Maverick counties; rises 4 miles north of Brackett; flows southwesterly 29 miles into Rio Grande; partially intermittent. Brackett topographic map.

LAS MORAS (HOWARDS CREEK).—Menard County; a small stream flowing 12 miles to its junction with San Saba River (tributary to the Colorado) near Menard in central part of the county.

LAS RAICES CREEK.—Lasalle County; small tributary in western part of county; flows eastward to its junction with Nueces River near the center of the county.

LATHAM CREEK.—San Saba County; in eastern part of county; tributary through Wallace Creek to San Saba River and thus to the Colorado; length, 7 miles. San Saba topographic map.

LAVACA RIVER.—Fayette, Lavaca, Jackson, and Calhoun counties; rises in southwestern corner of Fayette County, about midway between Flatonia and Moulton; flows southeastward 40 miles through Lavaca County, 34 miles through Jackson County, then 3 miles through Calhoun County into Lavaca Bay, and thus to Matagorda Bay and Gulf of Mexico, northeast of Port Lavaca. Flatonia topographic map.

LAVELLS LAKE.—Jefferson County; 2 miles north of LaBelle in central part of county; formation similar to river channel; lake approximately 6 miles long.

LAWZ CREEK.—Webb and Zapata couuties; small intermittent stream flowing southerly about 4 miles into San Juanita Creek (tributary to Rio Grande).

LEGARTO CREEK.—McMullen, Jim Wells, and Live Oak counties; rises 6 miles east of Lomo Alto in McMullen County; flows southeasterly into Jim Wells County, then northeasterly into Live Oak County into Nueces River near Legarto; length, 35 miles.

LEGION CREEK.—Llano County; a small stream flowing 6 miles to its junction with Sandy Creek a mile west of Lone Mountain, and thus to Colorado River in the southern part of the county. Fredericksburg and Llano topographic maps.

LEHEY CREEK.—Potter County; a stream rising in northern part of county and flowing southerly 3½ miles into Canadian River (tributary to Arkansas River and thus to the Mississippi).

LEMM GULLY.—Harris County; rises near Spring in northwestern part of county; flows southerly 3½ miles into Cypress Creek; intermittent. Spring topographic map.

LENTZ BRANCH.—Bastrop County; small stream rising 3 miles southeast of Redrock in the western part of county; flows northward 7 miles joining Walnut Creek (tributary to Colorado River) 3 miles east of Otis. Flatonia and Bastrop topographic maps.

LEON CREEK.—Bexar County; rises in northwestern part of county; flows southerly 40 miles into Medina River (tributary through San Antonio River to the Guadalupe) south of San Antonio. San Antonio topographic map.

LEON CREEK.—Victoria County; rises in northeastern part of county; flows eastward into Arenosa Creek and thus to Lavaca and Matagorda bays and Gulf of Mexico.

LEON RIVER.—Eastland, Comanche, Hamilton, Coryell, and Bell counties; about 2 miles southeast of Eastland, in northern part of Eastland County, formed by confluence of North and Middle Forks of Leon River; flows southeasterly 185 miles to its junction with Lampasas River to form Little River (tributary to the Brazos) in cenral part of Bell County, 7 miles southeast of Belton; principal towns along this stream are, Belton, Gatesville, and Eastland. Eastland, Stephenville, Hamilton, Meridian, Gatesville, Temple, and Taylor topographic maps.

LEON RIVER, MIDDLE FORK.—Eastland County; this fork may be considered the continuation of the main stream; rises 2½ miles east of Cisco; flows eastward 11 miles to its junction with North Fork Leon River, forming Leon River (tributary through Little River to the Brazos) 2 miles southeast of the town of Eastland. Eastland topographic map.

LEON RIVER, NORTH FORK.—Eastland County; rises 1 mile east of Cisco; flows northeastward and southeastward 5 miles uniting with Middle Fork Leon River 2 miles southeast of Eastland to form Leon River (tributary through Little River to the Brazos) in northern part of county. Eastland topographic map.

Leon River, South Fork.—Eastland County; rises near Scranton near Eastland-Callahan county line; flows northeasterly 22 miles into Middle Fork Leon River (tributary to Leon River, and thus through Little River to the Brazos) 1½ miles south of Eastland. Eastland topographic map.

Leona River.—Uvalde, Zavalla, and Frio counties; rises on the east side of Green Mountain (12 miles north of the town of Uvalde) at an approximate altitude of 1,600 feet above sea level; flows southerly and easterly 25 miles through Uvalde County, 29 miles through Zavalla County, thence 17 miles through Frio County into Frio River (tributary to Nueces River) near Derby. Above Uvalde this river does not carry water except during times of heavy precipitation. Uvalde topographic map.

Leoncito Creek.—McMullen County; rises in northwestern part of county; flows southeastward 13 miles into Frio River (tribuatry to the Nueces) near Tilden.

Leopard Creek.—Throckmorton County; a stream flowing easterly 7 miles to its junction with Brazos River near Elbert in northeastern part of county.

Levi Branch.—Kaufman County; small intermittent stream in northeastern part of county; flows into Buffalo Creek (tributary to East Fork of Trinity River, thence to the Trinity). Barnes Bridge topographic map.

Lewis Lake.—Bowie County; about 2 miles south of Bassett, in southwestern part of county; formed by old channel of Sulphur River (tributary to Red River and thus to the Mississippi).

Lick Branch.—Eastland County; small stream flowing southward 3½ miles into Leon River (tributary through Little River to the Brazos) southwest of Merriman. Eastland topographic map.

Lick Creek.—Franklin County; small stream flowing northerly through northeastern part of county joining Whiteoak Bayou (tributary to Sulphur River and thus through Red River to the Mississippi); length, 3 miles.

Lihe Creek.—Palo Pinto County; small stream flowing westward 4 miles into Brazos River north of Oaks Ferry in eastern part of county. Palo Pinto topographic map.

Lilly Creek.—Camp and Upshur counties; rises about 8 miles west of Pittsburgh in northwestern part of Camp County; flows southeasterly 22 miles into Little Cypress Creek (tributary to Caddo Lake and thus through Red River to the Mississippi) about 4 miles north of Gilmer in central part of Upshur County.

Lilly Creek.—Morris and Marion counties; rises in southeastern corner of Morris County; flows southward 3 miles into Big Cypress Bayou (tributary to Caddo Lake and thus through Red River to the Mississippi) in the northwestern part of Marion County.

Limestone Creek.—Hutchinson and Carson counties; rises in central part of Carson County; flows northerly 21 miles into Canadian River (tributary through Arkansas River to the Mississippi) 5 miles southwest of Plemons in southern part of Hutchinson County; intermittent.

Limpia Creek.—Jeff Davis and Pecos counties; rises 15 miles west of Fort Davis on southern slope of Davis Mountains, at an approximate elevation of 6,000 feet above sea level; flows eastward 10 miles to Fort Davis, thence northeastward 20 miles, then again eastward 25 miles into Paisano Creek (tributary to Pecos River and thus to Rio Grande) 8 miles north of Hovey. Valentine and Fort Davis topographic maps.

Lindleys Creek.—Walker and Montgomery counties; rises in southern part of Walker County; flows southwesterly 3 miles through Walker County, then 4 miles through Montgomery County into West San Jacinto River (tributary to San Jacinto River and thus to Galveston Bay and Gulf of Mexico.)

LINDSEY SPRING BRANCH.—Fannin County; small stream flowing into Bois d 'arc Creek (tributary to Red River and thus to the Mississippi) in southwestern part of county.

LINGUIST CREEK.—Briscoe, Floyd, and Motley counties; rises in the southeastern part of Briscoe County; flows southeasterly 10 miles into Quitaque Creek (tributary to Pease River and thus through Red River to the Mississippi) in the northwestern corner of Motley County.

LINN CREEK.—Angelina County; tributary to Neches River south of the town of Clawson in western part of county.

LINNVILLE BAYOU.—Brazoria and Matagorda counties; rises in northwest corner of Brazoria County; flows southeasterly 17 miles along the boundary between Brazoria and Matagorda counties into Caney Byou, and thence to Matagorda Bay and Gulf of Mexico; a lake is formed about 6 miles above mouth.

LINSCOME CREEK.—Caldwell County; rises north of Clark Chappell; flows through Dry Creek into Plum Creek and thus through San Marcos River to the Guadalupe. San Marcos topographic map.

LION CREEK.—Burnet County; small stream about 1 mile south of Bluffton in western part of county; flows westward 2½ miles into Colorado River. Burnet topographic map.

LIPAN CREEK.—Tom Green and Concho Counties; rises in southeastern part of Tom Green County; flows northeasterly 32 miles into Concho River (tributary to the Colorado), 7 miles west of Paint Rock in northwestern part of Concho County. Hayrick and San Angelo topographic maps.

LITTLE AGUJA CANYON.—Jeff Davis County; north branch of Big Aguja Creek; heads in Davis Mountains 10 miles northwest of Fort Davis; takes a northeasterly course about 35 miles to Toyah Creek (tributary to Pecos River and thus to Rio Grande) 2½ miles southwest of Toyahvale. Valentine and Fort Davis topographic maps.

LITTLE ALUM CREEK.—Bastrop County; in southeastern part of county; tributary through Alum Creek to Colorado River; length, 5 miles. Bastrop topographic map.

LITTLE ALUM CREEK.—Bastrop County; west of Otis in the southwestern part of the county; a branch of Alum Creek (tributary to Colorado River through Walnut Creek); length, 4 miles. Austin and Bastrop topographic maps.

LITTLE AQUILLA CREEK.—Hill County; rises 1 mile south of Cross Roads in northern part of county; flows southerly 10 miles into Aquilla Creek (tributary to Brazos River) 2 miles southwest of Peoria. Cleburne and Waco topographic maps.

LITTLE ARKANSAS CREEK.—Armstrong County; rises in western part; flows southerly 3 miles into Dry Creek (tributary to Prarie Dog Town Fork of Red River and thus through Red River to the Mississippi).

LITTLE BARTON CREEK.—Travis County; rises 4 miles east of Shingle Hills in western part of county; flows eastward 6 miles into Barton Creek (tributary to Colorado River), 3 miles southeast of Bee Caves. Blanco and Austin topographic maps.

LITTLE BEAR CREEK.—Collin County; rises 1 mile west of Pike; flows southwesterly 3 miles into Bear Creek (tributary to Pilot Grove Creek, thence through Sister Grove Creek and East Fork of the Trinity to Trinity River).

LITTLE BEAR CREEK.—Hamilton County; an intermittent stream northeast of Hamilton in western part of county; flows northeasterly 6 miles into Bear Creek (tributary to Leon River and thus through Little River to Brazos). Hamilton topographic map.

LITTLE BEAR CREEK.—Tarrant County; rises about 2 miles south of Keller; flows southeasterly 12 miles into Big Bear Creek (which discharges into Trinity River through the West Fork of Trinity), 2 miles northeast of Euless. Fort Worth topographic map.

LITTLE BLANCO RIVER.—Blanco, Comal, and Hays Counties; rises near Twin Sisters in the southern part of Blanco County; flows northeasterly 10 miles through Blanco County, 2 miles through a corner of Comal, then 4 miles through Hays County into Blanco River (tributary to San Marco River, and thus to the Guadalupe) in western part of Hays County south of Mount Sharp. Blanco topographic map.

LITTLE BLANCO RIVER.—Uvalde County; small intermittent stream in northeastern part of county; flows southerly 12 miles to its junction with Blanco River (tributary to Sabinal, Frio, and Nueces rivers), 4 miles north of Yucca Siding. Uvalde topographic map.

LITTLE BOGGEY CREEK.—Matagorda County; small stream in southern part of county; flows southerly 1 mile into Matagorda Bay and Gulf of Mexico.

LITTLE BRADY CREEK.—McCulloch County; a tributary 10 miles long joining Brady Creek (and thus through San Saba River to the Colorado) 8 miles southeast of Rochelle in the southeastern part of county. Brady topographic map.

LITTLE BRAZOS RIVER.—Limestone, Falls, Robertson, and Brazos counties; rises northwest of Kosse near the line of Limestone and Falls counties; flows southeastward 70 miles through Falls, Robertson, and Brazos counties into Brazos River near Stone City in the western part of Brazos County, southwest of Bryan; through Robertson and Brazos counties this stream flows parallel to, and from one to five miles northeast of Brazos River.

LITTLE BRUSHY CREEK.—Dewitt and Lavaca counties; rises in the eastern part of Dewitt County; flows eastward and southeastward 5 miles through Dewitt County, then 8 miles through Lavaca County into South Chicolete Creek to form Chicolete Creek, thence to Gulf of Mexico through Lavaca River and Matagorda Bay.

LITTLE BRUSHY CREEK.—Donley County; rises about 1½ miles north of Clarendon in central part of county; flows northeasterly 5 miles into Salt Fork of Red River (tributary to Prairie Dog Town Fork of the Red and thus through Red River to the Mississippi).

LITTLE CADDO CREEK.—Palo Pinto and Stephens counties; rises 4 miles southeast of Caddo in eastern part of Stephens County; flows northerly 8 miles into Big Caddo Creek (tributary to Brazos River) 4 miles west of Brad in western part of Palo Pinto County. Breckenridge topographic map.

LITTLE CAMP CREEK.—Hill and Johnson counties; a small stream flowing southerly 3 miles into Brazos River north of Kimball. Granbury topographic map.

LITTLE CANEY CREEK.—Hopkins and Wood counties; rises about 5 miles southwest of the town of Sulphur Springs in Hopkins County; flows southerly 14 miles into Lake Fork of Sabine River (tributary to the Sabine) about 5 miles northeast of Hoyt in Wood County.

LITTLE CANEY CREEK.—Hopkins County; rises about 5 miles northwest of Sulphur Springs in western part of county; flows southeasterly 15 miles into White Oak Bayou (tributary through Sulphur River to Red River and thus to the Mississippi).

LITTLE CEDAR CREEK.—Brazos County; rises in extreme northern part of county; flows northeasterly 8 miles into Navasota River (tributary to Brazos River) north of Edge.

LITTLE CEDAR BAYOU.—Harris County; rises 1 mile northwest of LaPorte; flows southeasterly 2¾ miles into Galveston Bay and thus to Gulf of Mexico; intermittent. LaPorte topographic map.

LITTLE CEDAR CREEK.—Stephens County; rises 2 miles west of LaCasa in southeastern part of county; flows northerly 15 miles into Big Cedar Creek (tributary to Brazos River) 2½ miles north of C. J. Mountain. Breckenridge topographic map.

LITTLE COW CREEK.—Newton County; rises in northwestern part of county; flows southeasterly 24 miles into Sabine River about 8 miles southeast of Burkeville.

LITTLE CREEK.—Dallas and Ellis counties; rises near Cedar Hill in Dallas County; flows southeasterly 8 miles into Red Oak Creek (tributary to Trinity River) 2 miles northwest of Red Oak in Ellis County. Dallas topographic map.

LITTLE CREEK OR NORTH PRONG OF MILL CREEK.—Red River and Bowie counties; rises about 5 miles northeast of Annona in eastern part of Red River County; flows northeasterly 13 miles into Mill Creek (tributary to Red River and thus to the Mississippi) about 8 miles northeast of Oakgrove in northwestern part of Bowie County.

LITTLE CYPRESS BAYOU OR CREEK.—Marion, Harrison, Upshur, Gregg, and Camp counties; rises about 2 miles east of Leesburg in western part of Camp County; flows eastward 63 miles to a point 4 miles east of Jefferson in southern part of county, where it enters Caddo Lake (tributary to Red River and thus to the Mississippi).

LITTLE CYPRESS CREEK.—Burnet County; tributary to Colorado River in the southeastern corner of the county; length, 8 miles. Blanco topographic map.

LITTLE CYPRESS CREEK.—Harris County; rises in northwestern part of county just west of Hockley; flows southeasterly 18 miles into Big Cypress Creek, 3 miles northeast of Big Cypress School, thence to Cypress and Spring creeks, and thus through San Jacinto River to Galveston Bay and Gulf of Mexico; intermittent. Hockley, Rose Hill, Cypress, Waller, and Ashford topographic maps.

LITTLE CYPRESS OR STEPHENS CREEK.—Cass County; rises at Bloomburg in northeastern part of county; flows northerly 8 miles into Sulphur River (tributary to Red River and thus to the Mississippi) about a mile southeast of Spencer Spur. Atlanta topographic map.

LITTLE CYPRESS CREEK.—Newton County; southern part; small tributary to Big Cypress Creek (tributary to the Sabine).

LITTLE DEER CREEK.—Falls County; rises near Lott; flows northeasterly 6 miles into Deer Creek (tributary to Brazos River) in western part of county. Temple topographic map.

LITTLE DRY BRUSHY CREEK.—Williamson County; rises in southern part of county; flows northeasterly 6 miles into Brushy Creek (tributary to San Gabriel River and thus through Little River to the Brazos) southeast of Taylor. Taylor and Bastrop topographic maps.

LITTLE DUCK CREEK.—Kent County; small stream flowing southerly 10 miles into Salt Fork of Brazos River (tributary to the Brazos).

LITTLE DUFFAU CREEK.—Erath County; rises 2 miles northeast of Selden; flows southeasterly 12 miles into Duffau Creek (tributary to Bosque River and thus to the Brazos) 3 miles southeast of Duffau near Erath-Bosque county line. Stephenville and Granbury topographic maps.

LITTLE ELKHART CREEK.—Houston County; rises in northern part of county; flows southwesterly 13 miles into Elkhart Creek (tributary to Trinity River).

LITTLE ELM CREEK.—Bell County; rises 2 miles south of Pendleton, in northern part of county; flows southeasterly 14 miles into Big Elm Creek (which discharges into Brazos River through Little River) 9 miles southeast of Temple. Temple topographic map.

LITTLE ELM CREEK.—Grayson, Collin, and Denton counties; rises about 3 miles southwest of Gunter in Grayson County; flows southwesterly 23 miles into Elm Fork of Trinity River (tributary to Trinity River) 3 miles east of Lewisville in southeastern part of Denton County.

LITTLE ELM CREEK.—Taylor County; rises in Lewis Canyon; flows northeasterly 17 miles into Elm Creek (tributary through Clear Fork of the Brazos to Brazos River) 3½ miles northwest of Abilene. Anson and Abilene topographic maps.

LITTLE FIVEMILE CREEK.—Fayette County; west of Flatonia in the southwestern part of county; an intermittent tributary to Big Fivemile Creek, and thus through Peach Creek to Guadalupe River. Flatonia topographic map.

LITTLE FLATROCK CREEK.—Burnet County; a stream 5 miles in length flowing into Flatrock Creek (tributary to Colorado) south of Marble Falls in southern part of the county. Burnet topographic map.

LITTLE FOSSIL CREEK.—Tarrant County; rises 7 miles north of Fort Worth; flows southeasterly 8 miles into Big Fossil Creek (tributary to West Fork of the Trinity, thence to Trinity River) a short distance above its mouth, about 5 miles northeast of Fort Worth. Fort Worth topographic map.

LITTLE GAP CREEK.—Collingsworth County; a stream flowing southeasterly through northwestern part of county into Salt Fork of Red River (tributary through Prairie Dog Town Fork of the Red to Red River and thus to the Mississippi); length, 6 miles.

LITTLE GRAPE CREEK.—Garza County; rises in southeastern part of county; flows northerly 6 miles into Double Mountain Fork of Brazos River (tributary to the Brazos).

LITTLE GREEN CREEK.—Erath County; rises 5 miles west of Alexander in southern part of the county; flows easterly 8 miles into Green Creek (which discharges into Brazos River through Bosque River). Stephenville topographic map.

LITTLE INDIAN CREEK.—Shackelford County; rises 5 miles southeast of Albany; flows southeasterly 3½ miles into Indian Creek (tributary through Hubbard Creek to Gonzales Creek and thus through Clear Fork of Brazos River to the Brazos). Albany topographic map.

LITTLE JIMMYS CREEK.—Brown and Comanche counties. See Martins Creek.

LITTLE KEECHIE CREEK.—Palo Pinto and Jack counties; a stream flowing southward 15 miles into Brazos River, 5 miles southwest of Graford in northern part of Palo Pinto County. Palo Pinto topographic map.

LITTLE INDIAN CREEK.—Shackelford County; rises 5 miles southeast of Albany; flows southeasterly 3½ miles into Indian Creek (tributary through Hubbard Creek to Gonzales Creek and thus through Clear Fork of Brazos River to the Brazos). Albany topographic map.

LITTLE KEECHIE CREEK.—Palo Pinto and Jack counties; a stream flowing southward 15 miles into Brazos River, 5 miles southwest of Graford in northern part of Palo Pinto County. Palo Pinto topographic map.

LITTLE LAKE CREEK.—Montgomery County; rises in the northwestern part of county; flows southeasterly 12 miles into West San Jacinto River, thence to San Jacinto River, Galveston Bay, and Gulf of Mexico.

LITTLE LAKE.—Cass County; about 5 miles west of Alamo Mills in northeastern part of county; formed by an old channel of Sulphur River (tributary to Red River, which discharges into the Mississippi). Texarkana topographic map.

LITTLE LOCO CREEK.—Nacogdoches County; flows southerly 8 miles into Bayou Loco (tributary to Angelina River and thus to the Neches) in southwestern part of county.

LITTLE LLANO RIVER.—San Saba and Llano counties; rises near Taylorville in the southeastern part of San Saba County; flows southeasterly 3½ miles through San Saba County, then 10½ miles through Llano County into Llano River (tributary to Colorado River) 2 miles south of Lone Grove in the northeastern part of Llano County. Llano topographic map.

LITTLE LUCY CREEK.—Lampasas County; rises near Cedar Top Peak; flows northeasterly 8 miles into Big Lucy Creek (tributary to Lampasas River and thus through Little River to the Brazos) 7 miles northeast of the town of Lampasas. Lampasas topographic map.

LITTLE MARY CREEK.—Parker County; rises about 4 miles north of Aledo; flows southeasterly 5 miles into Marys Creek (tributary to Clear Fork of Trinity River, thence through West Fork of the Trinity to Trinity River) near the eastern boundary of Parker County. Weatherford topographic map.

LITTLE MINERAL CREEK.—Grayson County; an intermittent stream rising at Pottsboro in western part of county and flowing northerly 9 miles into Red River (tributary to the Mississippi) about 1½ miles south of Preston. Denison topographic map.

LITTLE MOUNTAIN CREEK.—Comanche County; rises south of Fleming near Comanche-Mills county line; flows northeasterly into South Leon Creek (tributary to Leon River and thus through Little River to the Brazos) 2 miles southwest of Fleming. Brownwood and Hamilton topographic maps.

LITTLE MUELA CREEK.—Uvalde County; unites with Muela Creek (thence to Nueces River through Chapparosa, Turkey, and Elm creeks) near the corner of Kinney, Uvalde, Maverick, and Zavalla counties; length, 6 miles. Brackett topographic map.

LITTLE MUSTANG CREEK.—Red River County; rises near Wayland in southwestern part of county; flows southeastward 12 miles into Sulphur Creek (tributary to Red River and thus to the Mississippi).

LITTLE PECAN CREEK.—Clay County; an intermittent stream flowing into Red River (tributary to the Mississippi) in northeastern part of county 2½ miles northeast of Stanfield. Montague topographic map.

LITTLE PERDIDO CREEK.—Goliad County; small stream in northeastern part of county; head fork of Perdido Creek (tributary through Coleto Creek to Guadalupe River).

LITTLE PINE CREEK.—Red River County; rises about 9 miles southwest of Albion in northern part of county; flows northeasterly 9 miles into Pine Creek (tributary to Red River and thus to the Mississippi) about 2 miles west of Albion.

LITTLE PINEY BRANCH.—Bastrop County; 1 mile northwest of Upton in the central part of the county; small intermittent tributary to Colorado River; length, 5 miles. Bastrop topographic map.

Little Pin Oak Creek.—Bastrop and Fayette counties; small intermittent stream flowing through the southeastern part of Bastrop County and the northwestern part of Fayette County into Pin Oak Creek and thus to Colorado River; length, 9 miles. Bastrop and Flatonia topographic maps.

Little Piney Creek.—Bowie County; small stream about 1½ miles north of Bassett; flows into Bassett Creek (tributary to Sulphur River and thus through Red River to the Mississippi) in southwestern part of county.

Little Pine Island Bayou.—Hardin County; rises near Votaw in the northwestern corner of the county; flows southeasterly 45 miles into Pine Island Bayou (tributary to Neches River) about 12 miles northwest of Beaumont.

Little Pond Creek.—Falls County; rises near Barclay; flows southeastward 11 miles into Pond Creek (tributary to the Brazos) near Falls-Milam county line. Temple topographic map.

Little Postoak Creek.—Archer and Clay counties; formed about 11 miles northeast of Archer City near county line in eastern part of county by the junction of East and West Little Postoak creeks; flows northeasterly 2½ miles into Postoak Creek (tributary to Littel Wichita River and thus through Red River to the Mississippi) about a mile east of the Clay-Archer county line in western part of county.

Little Red River.—Briscoe and Hall counties; rises about 2 miles from eastern county line in southeastern part of Briscoe County; flows northeasterly 14 miles into Prairie Dog Town Fork of the Red (tributary to Red River, which discharges into the Mississippi) in the central part of Hall County.

Little Red Mud Creek.—Kent County; rises near Kent-Dickens county line; flows southerly 7 miles into Salt Fork of Brazos River (tributary to the Brazos) 1 mile east of the mouth of White River, in northwestern part of county.

Little River.—Bell and Milam counties; formed 7 miles southeast of Belton in central part of Bell County by union of Leon and Lampasas rivers; flows southeasterly 75 miles into Brazos River at a point 3 miles northwest of Valley Junction in eastern part of Milam County; passes near the town of Cameron in Milam County; gaging station at Cameron. Area of drainage basin, 7,560 square miles. Taylor topographic map.

Little Rocky Creek.—Bosque County; joins Brazos River north of the village of Merrivale in southeastern part of county; length, 3 miles. Waco topographic map.

Little Rocky Creek.—Washington County; rises one-half mile south of Independence in northern part of county; flows southerly 4 miles into Rocky Creek (tributary to Brazos River). Gay Hill topographic map.

Little Saline Creek.—Smith County; rises about 2 miles northeast of Hopewell; flows northeasterly 10 miles into Sabine River about 6 miles northwest of Winona.

Little Saline Creek, East Fork of.—Smith County; small stream flowing into Little Saline Creek (tributary to the Sabine) west of Winona in northern part of county.

Little Sandy Creek.—Bastrop County; rises near Elgin; flows southeastward 8 miles into Big Sandy Creek (tributary to Colorado River) about 1 mile northwest of Sayersville. Bastrop topographic map.

Little Sandy Creek.—Collingsworth County; a stream 2 miles long rising in central part of county and flowing into Salt Fork of Red River (tributary to Prairie Dog Town Fork of the Red and thus through Red River to the Mississippi).

LITTLE (EAST) SANDY CREEK.—Eastland and Stephens counties; rises 2 miles southwest of Flat Top Mountain in northern part of Eastland County; flows northerly 8 miles into Sandy Creek (tributary to Hubbard Creek thence through Gonzales Creek and Clear Fork of Brazos River to the Brazos) 5 miles northwest of Gunsight. Eastland and Breckenridge topographic maps.

LITTLE SANDY CREEK.—Lamar and Red River counties; rises about 7 miles southeast of Paris in eastern part of Lamar County; flows southeasterly 21 miles into Sulphur River (tributary to Red River, which discharges into the Mississippi) one-half mile east of southwestern corner of county in northwestern part of Red River County.

LITTLE SANDY CREEK.—Wood County; flows southeasterly 9 miles into Sabine River in southeastern part of county.

LITTLE SHAWNEE CREEK.—Rusk County; rises about 3 miles northeast of Henderson; flows southwesterly 8 miles into Big Shawnee Creek and thus to Angelina and Neches rivers.

LITTLE SILVER CREEK.—Parker County; a small stream flowing into Silver Creek (tributary to West Fork of Trinity River and thus to the Trinity) in the northeastern part of the county. Weatherford topographic map.

LITTLE STINKING CREEK.—Stonewall and Kent Counties; a northeastward flowing stream joining Salt Fork of Brazos River (tributary to Brazos River); length, 8 miles.

LITTLE SUNDAY CREEK.—Palo Pinto and Erath counties; rises at Wyleyville in northern part of Erath County; flows northeasterly 13 miles into Big Sunday Creek (which discharges through Palo Pinto Creek to Brazos River) 4 miles west of Jacobs Wells in southern part of Palo Pinto County. Stephenville and Palo Pinto topographic maps.

LITTLE WALNUT CREEK.—Travis County; rises 2 miles northwest of the town of Fiskville; flows southeastward 7 miles through the central part of the county into Walnut Creek and thus to Colorado River. Austin topographic map.

LITTLE WHITEOAK CREEK.—Upshur County; rises about 3 miles southeast of Calloway; flows southeasterly 12 miles; enters Sabine River 2 miles west of Red Rock.

LITTLE WHITE ROCK CREEK.—Trinity County; rises in the northern part of the county; flows southwesterly 16 miles into White Rock Creek (tributary to Trinity River) about 3 miles northeast of Trinity.

LITTLE WICHITA RIVER.—Archer and Clay counties; formed 3 miles northeast of Archer City, in central part of Archer County, by union of the North and Middle Forks of Little Wichita River; flows northeasterly about 45 miles into Red River (tributary to the Mississippi) in northeastern part of Clay County 2½ miles west of Terral, Okla. Montague topographic map.

LITTLE WICHITA RIVER—MIDDLE FORK OR THOMAS CREEK.—Archer County; rises in southwestern part of county; flows northeastward 13 miles to a point about 3 miles northeast of Archer City, where it unites with North Fork of Little Wichita River to form Little Wichita River (tributary to Red River, which discharges into the Mississippi).

LITTLE WICHITA RIVER, SOUTH FORK.—Archer County; rises in southwestern part of county; flows northeasterly 21 miles to its junction with Middle Fork of Little Wichita River (tributary to Little Wichita and Red rivers and thus to the Mississippi) near Archer City.

LIVERPOOL CREEK.—Jackson County; a stream flowing southerly through southern part of county into Clarks Creek and thus to the Lavaca, Matagorda Bay and Gulf of Mexico; length, 3 miles.

LLANO RIVER.—Kimble, Mason, and Llano counties; formed near Junction in center of Kimble County by union of North and South Llano rivers; flows in an easterly course about 100 miles through the central part of Mason and Llano counties to its junction with Colorado River at Kingsland in the southeastern part of Llano County; drainage area, which includes areas of North and South Llano rivers, 4,460 square miles. Gaging station near Junction. Mason, Llano, and Burnet topographic maps.

The greater part of the irrigable area of this drainage is above Junction, although some lands are irrigated below that point. Water power has been developed at Junction and Mason and additional sites exist along the stream.

See Second Report of Texas Board of Water Engineers for list of certified filings of appropriations for use of water.

LLAVE CREEK.—Webb County; small intermittent stream rising in western part of the county and flowing southwesterly 5 miles into Rio Grande.

LOAFER CREEK.—Mason and McCulloch counties; a stream 9 miles long flowing through the southeastern part of McCulloch County and the northeastern part of Mason County into Tiger Creek (tributary through San Saba River to the Colorado) east of Camp San Saba. Brady and Mason topographic maps.

LOCKWOOD DRAW.—Garza County; rises in northwestern part of county; flows easterly 4 miles into North Fork of the Double Mountain Fork of Brazos River (tributary through Double Mountain Fork of the Brazos to Brazos River).

LOCO CREEK.—Nacogdoches County; small headwater stream of Bayou Loco (tributary to Angelina River and thus to the Neches) in western part of county.

LODGE CREEK.—Clay and Jack counties; rises in the southern part of Clay County; flows southeasterly 10 miles into West Fork of Trinity River (tributary to the Trinity) in the northwestern part of Jack County.

LONE TREE CREEK.—Armstrong and Donley counties; rises in southeast part of Armstrong County; flows easterly 13 miles into Mulberry Creek (tributary to Prairie Dog Town Fork of Red River and thus through Red River to the Mississippi) in southwestern part of Donley County.

LONE TREE CREEK.—Wharton County; small tributary to West Bernard River (thence to San Bernard River and Gulf of Mexico) in the northern part of the county; flows easterly.

LONE GUM TREE CREEK.—Wharton County; small tributary to West Bernard River (thence to San Bernard River and Gulf of Mexico) in northern part of county; flows northeasterly.

LONE WOLF CREEK.—Mitchell County; rises in northeastern corner of county; flows southwestward about 11 miles to its junction with Colorado River at the town of Colorado in the north central part of county.

LONG BRANCH.—Archer County; rises about 8 miles northeast of Archer City in eastern part of county; flows easterly 8 miles into Little Wichita River (tributary through Red River to the Mississippi).

LONG BRANCH.—Cooke County; a small intermittent tributary about 2 miles west of Three Mounds in northern part of county; flows into North Fish Creek (which discharges into Red River through Fish Creek, and thus to the Mississippi). Gainesville topographic map.

LONG BRANCH.—Cooke County; a small stream flowing into Elm Fork of Trinity River (tributary to the Trinity) southwest of the town of Muenster in southwestern part of county; intermittent. Gainesville topographic map.

LONG BRANCH.—Eastland County; rises 2 miles north of Romney; flows southeasterly 7 miles into Sabanna River (tributary through Leon River to Little River, and thus to Brazos) 6 miles southwest of Carbon in southern part of county. Eastland topographic map.

LONG BRANCH.—Guadalupe County; south of Kingsbury; small intermittent stream flowing through the east-central part of the county into Mill Creek (tributary to the Guadalupe). San Marcos topographic map.

LONG BRANCH.—Lavaca County; small stream flowing southerly into Lavaca River (thence to Gulf of Mexico through Matagorda Bay) in the northwestern part of county; length, 5 miles. Flatonia topographic map.

LONG BRANCH.—Motley County; rises about 5 miles southwest of Matador in central part of county; flows northeasterly 11 miles into Ballard Creek (tributary through Middle Pease River to Pease River, and thus through Red River to the Mississippi) about 6 miles northeast of Matador.

LONG BRANCH.—McLennan County; a short stream in western part of county; rising 2½ miles east of Patton and flowing easterly 5 miles into Bosque River (tributary to the Brazos). Waco topographic map.

LONG BRANCH.—Wise County; small stream flowing into Callett Creek (tributary to Denton Creek, and thus through Elm Fork of the Trinity to Trinity River) in eastern part of the county.

LONGS BRANCH.—Jackson County; rises in northern part of the county; flows southeasterly 14 miles into Sandy Creek (thence to Gulf of Mexico through Navidad and Lavaca rivers and Matagorda Bay).

LONG BRANCH.—Stephens County; small intermittent tributary to Bufford Creek, thence to Brazos River in northern part of county. Breckenridge topographic map.

LONG BRANCH.—Runnels County; an intermittent stream 6 miles long northeast of Ballinger in the southern part of the county; flows into the Colorado. Ballinger topographic map.

LONG CREEK.—Hood and Parker counties; rises 1 mile south of Parsons in southern part of Parker County; flows southwesterly 11 miles into Brazos River 3 miles southwest of Center Mill in northern part of Hood County. Weatherford topographic map.

LONG CREEK.—Throckmorton County; small stream 2 miles in length flowing southeasterly into Leopard Creek (tributary to the Brazos) near mouth of Leopard Creek in northeastern part of county.

LONG CREEK.—Shackelford County; a stream flowing westerly 13 miles into Deadman Creek (tributary to Clear Fork of Brazos River and thus to the Brazos) near Rising Sun in western part of county. Albany and Anson topographic maps.

LONG CREEK.—Wilbarger and Wichita counties; rises about one-half mile from the county line in southeastern part of Wilbarger County; flows northeasterly 8 miles into Beaver Creek (tributary to Wichita River and thus through Red River to the Mississippi) in southwestern part of Wichita County.

LONG CANYON CREEK.—Dickens County; rises in eastern part of county; flows southeasterly 10 miles into South Wichita River, thence to the Wichita and thus through Red River to the Mississippi.

L[illegible] [illegible]—[illegible] part of county, 2½ miles [illegible] of Electra [illegible] miles into Red River and thus [illegible] Burkburnett and Electra topographic maps.

Long [illegible].—[illegible] by union of several [illegible] and southeasterly [illegible] miles [illegible] Rio Grande; intermittent. Marfa [illegible] map.

Long Hollow.—[illegible] stream in the northwestern part of [illegible] Sandy Fork of Peach Creek [illegible] River [illegible] southwest of [illegible]. [illegible] map.

Long Hollow.—[illegible] stream; flows southerly 9 miles [illegible] Nueces River) 1 mile [illegible] map.

Long Hollow.—[illegible] tributary to East Nueces River [illegible] north of Uvalde [illegible] 6 miles. Uvalde topographic map.

Long John Hollow.—[illegible] northwestern part of county; [illegible] East Nueces River and thus to Nueces River. [illegible] map.

Long King Creek.—[illegible] in the central part of the county; [illegible] 2 miles south of Goodrich at the crossing of the [illegible] East & West Texas Railway Company.

Long Waterhole Branch.—San Saba County; a stream three miles long flowing through the southeastern part of the county into Marley Creek and thus to the Colorado through Fall Creek. Llano and San Saba topographic maps.

Long Tom Creek.—Trinity and Polk counties; rises in the southern part of Trinity County; flows easterly 7 miles through Trinity County, then southerly 19 miles through Polk County into Long King Creek (tributary to Trinity River) north of Livingston.

Long Draw.—Presidio County; rises in northern part of the county at an approximate altitude of 5,770 feet above sea level; takes an easterly course 20 miles to Alamita Creek (tributary to Rio Grande) 12 miles south of Marfa; intermittent. Marfa topographic map.

Long Run.—Stephens County; rises near southern Eastland County line; flows northerly 7 miles into Sandy Creek (tributary through Hubbard Creek to Gonzales Creek and Clear Fork of Brazos River, thence to the Brazos) in southwestern part of the county. Albany and Breckenridge topographic maps.

Long Slough.—Cass County; a channel of Sulphur River heading about 2 miles north of Alamo Mills and taking a southeasterly course; entering Sulphur River at State line; length, 4 miles. (Red and Mississippi rivers drainage). Texarkana topographic map.

Lopez Creek.—Irion County; small stream flowing eastward 8 miles through the southeastern part of the county to its junction with Spring Creek (tributary to Middle Concho River and thus through South Concho and Concho Rivers to the Colorado) 1½ miles northeast of Sherwood. Sherwood topographic map.

Lorino Branch.—Cooke County; small intermittent tributary to Clear Creek (which discharges into Elm Fork of Trinity River, thence to the Trinity) in the southwestern part of the county. Gainesville topographic map.

Los Achies Creek.—Oldham County; rises 10 miles northwest of Adrian; flows northwesterly 13 miles into Canadian River (tributary through Arkansas River to the Mississippi) 18 miles north of Adrian in western part of county; intermittent.

Los Moras Creek.—Kinney and Maverick counties; rises 4 miles north of Bracketville in the central part of Kinney County; flows southwesterly approximately 25 miles into Rio Grande, 5 miles north of Quemado. Brackett topographic map.

Los Morteros Creek.—Starr County; a small intermittent stream rising in western part of the county and flowing southerly 6½ miles to its junction with Rio Grande, about 1 mile northwest of Salineno.

Los Olmos Creek.—Webb and La Salle counties; rises 2 miles west of Cactus, on International & Great Northern Railway; flows northeasterly 13 miles through Webb County, then 5 miles through La Salle into Nueces River, in south central part of county.

Loss Creek.—Edwards and Kinney counties; a small intermittent tributary to Sycamore Creek (thence to Nueces River through Silver Lake and West Nueces River) in the northeastern part of Kinney County and southern part of Edwards; flows westerly 11 miles. Nueces topographic map.

Lost Creek.—Cass County; small intermittent stream flowing into Frazier Creek (tributary to Caddo Lake and thus through Red River to the Mississippi), about 7 miles north of Linden, in central part of county.

Lost Creek.—Coleman County; south of the town of Coleman in the central part of the county; flows through Home Creek into Colorado River; length, 8 miles. Coleman topographic map.

Lost Creek.—Collingsworth County, Tex., and Beckham County, Okla.; rises in northeastern part of Collingsworth County, Tex.; flows southeasterly 3 miles to its intersection with the Texas-Oklahoma boundary line, thence southerly through Beckham County, Okla., to Elm Fork of Red River (tributary through North Fork of Red River to the Red and thus to the Mississippi).

Lost Creek.—Donley County; small stream flowing through northern part of county into Saddlers Creek (tributary to Salt Fork of Red River and thus through Prairie Dog Town Fork of the Red and Red River to the Mississippi).

Lost Creek.—Erath County; rises 1 mile southeast of Wyleyville in northern part of county; flows northerly 10 miles into Big Sunday Creek (tributary to Palo Pinto Creek and thus to Brazos River) near Palo Pinto-Erath county line. Stephenville and Palo Pinto topographic maps.

Lost Creek.—Houston County; a stream flowing southwesterly 9 miles into Caney Bayou (tributary to Trinity River) in the southwestern part of the county.

Lost or Shoal Creek.—Jack County; rises about 4 miles southwest of Jacksboro; flows northeasterly 12 miles into West Fork of Trinity River (tributary to Trinity River) 6 miles northeast of Jacksboro.

Lost Creek.—Lavaca County; small stream in southern part of county; flows southeastward 3 miles into Clarks Creek and thus to Lavaca River, Matagorda Bay, and Gulf of Mexico.

Lost Creek.—Motley County; rises about 7 miles northwest of Matador in western part of county; flows northeastward 2½ miles into Middle Pease River (tributary to Pease River and thus through Red River to the Mississippi).

L[illegible]—[illegible]; rises 3½ miles southwest of Clara in [illegible] [illegible] about 6 miles into North Fork of Buffalo [illegible] Buffalo Creek and Wichita River, and thus to Red [illegible] [illegible]. Clara and Iowa Park topographic map[illegible]

Lost C[illegible]—M[illegible] and Harris counties; rises in southeastern part [illegible] M[illegible] northeast of Moonshine Hill; flows [illegible] [illegible] J[illegible] River and thus to Gulf of Mexico; [illegible] [illegible] Moonshine Hill topographic map.

Lost C[illegible]—S[illegible] and McCulloch counties; small stream in southea[illegible] part of McCulloch and southwestern part of San Saba counties, [illegible] [illegible]; flows through Loafer Creek into Tiger Creek (tributary t[illegible] San Saba River and thus to the Colorado); length, 6 miles. Mason topogr[illegible] map.

Lost M[illegible] Creek.—Briscoe and Hall counties; rises in eastern part of [illegible] [illegible] County; flows northeasterly 5 miles into Little Red River (trib[illegible] to Prairie Dog Town Fork of Red River, which discharges into the [illegible] sissippi through Red River) in Hall County at its intersection with [illegible] west line of county.

Lost Lake.—Harris County; one mile west of Lynchburg in southeastern [illegible] of county; an arm of Buffalo Bayou; about 2 miles long. Burnett [illegible] topographic map.

Loveless Creek.—Palo Pinto County; a small stream flowing southerly 4 m[illegible] into Brazos River near Pickwick in northwestern part of county. P[illegible] Pinto topographic map.

Low Branch.—Tarrant and Johnson counties; joins Mountain Creek (tri[illegible] tary to West Fork of Trinity River, thence to the Trinity) east of M[illegible] [illegible]. Fort Worth topographic map.

Lower Keechi Creek.—Leon County; about 3 miles east of Jewett; head [illegible] Keechi Creek (tributary to Trinity River).

Lowe or Dry Creek.—Val Verde County; an intermittent stream; rises [illegible] northeastern corner of county; takes an easterly course 6½ miles [illegible] Buckleys Creek and thus to Devil's River and Rio Grande.

Lucas Creek.—Atascosa and Wilson counties; rises in northwestern part of Wilson County; flows southeastward 7 miles through Atascosa County into Borrego Creek (tributary to Nueces River through Atascosa and Frio rivers).

Lucas Creek.—Bexar County; an intermittent stream in the western part of county; flows into Medina River and thus to the San Antonio (tributary to Guadalupe River) northwest of Macdona. San Antonio topographic map.

Luce Bayou.—Liberty and Harris counties; rises in northwestern part of Liberty County; flows southwesterly 2 miles through Liberty, then 6 miles through Harris County into East San Jacinto River (tributary to San Jacinto River and Gulf of Mexico). Huffman topographic map.

Lynch Creek.—Lampasas County; rises near Twin Sister Peaks; unites with Colorado River 2 miles east of Ben in the southwestern part of county; length, 9 miles. Lampasas topographic map.

Lynn Creek.—Hunt County; small stream flowing into Wolf Creek (tributary to Cowleach Fork of Sabine, Caddo Fork of Sabine, and Sabine rivers) about 4 miles east of Greenville.

Lynn Creek.—Jack County; small stream flowing through northwestern part of county to Lake Valley Creek (which discharges into Trinity River through West Fork of the Trinity) south of Antelope.

Lynn Bayou.—Waller County; rises 4 miles north of Hemstead; flows southerly 8 miles into Brazos River 4 miles southwest of Hemstead.

TLE CREEK.—Taylor and Jones counties; rises near Potosi; flows northerly 20 miles into Elm Creek (tributary through Clear Fork of Brazos River to the Brazos) 6 miles north of Abilene in southeastern part of Jones County. Anson and Abilene topographic maps.

TTON CREEK.—Bastrop County; rises in northwestern part of county; flows southeastward 7 miles to its junction with Walnut Creek (tributary to Colorado River) 2 miles north of Miers. Austin and San Marcos topographic maps.

LACHAE CREEK.—Coke County; an intermittent stream 5 miles long southwest of Hayrick in the eastern part of the county; flows into Colorado River. Hayrick topographic map.

LADERA CANYON.—Jeff Davis County; rises on northern slope of Baldy Peak in Davis Mountains 17 miles west of Fort Davis at an approximate altitude of 7,500 feet above sea level; flows northeastward to junction with Aguja Creek to form Toyah Creek (tributary through Pecos River to Rio Grande) 2½ miles southwest of Toyahvale. Valentine and Fort Davis topographic maps.

MADERA CANYON.—Presidio County; short canyon in southern part of county; flows southerly 5 miles into Rio Grande 9 miles west of Lajitas. Terlingua topographic map.

MAGILL CREEK.—Llano County; an intermittent stream 3 miles in length flowing into Pecan Creek (tributary through Llano River to the Colorado) in the northern part of the county. Llano topographic map.

MAGNOLIA CREEK.—Sabine County; small tributary to Richland Creek (thence through Sixmile Creek to Sabine River) in southeastern part of county.

MAGOY CREEK.—Terrell County; rises in southern part; flows into Prairie Creek; intermittent. Dryden Crossing topographic map.

MAHARD CREEK.—Travis and Bastrop counties; rises near Creedmor in the southern part of Travis County; flows eastward 20 miles to its junction with Cedar Creek (tributary through Walnut Creek to Colorado River) 3 miles northeast of Glass. Austin topographic map.

MAIN CREEK.—Donley County; rises in eastern part; flows northerly 1½ miles into Salt Fork of Red River, which discharges into the Red through Prairie Dog Town Fork of the Red and thus to the Mississippi.

MAJ. LONGS CREEK.—Hartley County, Tex., and Union County, N. Mex.; rises in central part of Union County, northeastern New Mexico, enters Texas in northwestern part of Hartley County, and flows southeasterly 45 miles into Mustang Creek (tributary to Canadian River, and thus through the Arkansas to Mississippi River) 5 miles west of Channing in southern part of county; intermittent.

MALDEN LAKE (MCFARLAND LAKE).—Bowie County; about 5 miles south of Maud in southern part of county; formerly an old channel of Sulphur River (tributary to Red River and thus to the Mississippi). New Boston topographic map.

MALHIOLUM CREEK.—Bell and Coryell counties; a stream flowing southeasterly 8 miles to a point north of Moffatt, where it enters Leon River and thus through Little River to the Brazos. Gatesville and Temple topographic maps.

MALLARD CREEK.—Montague County; rises about 2 miles northwest of Dye; flows southwesterly 8 miles into Denton Creek (tributary to Elm Fork of Trinity River, and thence to Trinity River) about a mile east of Denver; intermittent. Montague topographic map.

Mammoth Creek.—Lipscomb County: rises 13 miles north of the village of Lipscomb; flows southeasterly 20 miles into Wolf Creek (tributary to North Fork of Canadian River; and thus through Canadian and Arkansas rivers to the Mississippi) 7 miles west of Shattuck, Okla.

Manahuilla Creek.—Dewitt and Goliad counties; rises near Nordheim in the southwestern part of Dewitt County: flows southeasterly 6 miles through Dewitt County, then 23 miles through Goliad County into San Antonio River (tributary to Guadalupe River) 6 miles southeast of Goliad.

Mansker Lake.—Eastland County; near Alameda, 11 miles southeast of Eastland, 6¼ miles northwest of Desdimonia, one-half mile east of Leon River (Brazos River drainage) in eastern part of county; very small. Eastland topographic map.

Maravilla Creek.—Brewster County; formed by the union of Calamity and Goat creeks, 30 miles south of Alpine: flows southeasterly 60 miles into Rio Grande, 40 miles south of Longfellow; intermittent.

Marble Bank Creek.—Kent County; a stream flowing southeasterly 8 miles into Duck Creek (tributary to Salt Fork of Brazos River and thus to the Brazos) in northern part of county.

Marcelinas Creek.—Wilson and Karnes counties; rises in central part of Wilson County; flows southeasterly 17 miles through Wilson County, then 4 miles through Karnes County into San Antonio River (tributary to Gaudalupe River) near Falls City.

Marcado Creek.—Victoria County; rises near the center of county; flows eastward 4 miles into Gariolas Creek (thence to Gulf of Mexico through Arenosa Creek, Lavaca and Matagorda bays).

Margaret Creek.—Hemphill and Roberts counties; rises near Roberts-Hemphill county line 11 miles northwest of Canadian; flows southeasterly 5 miles to its junction with Canadian River (tributary through Arkansas River to the Mississippi) 7 miles northwest of Canadian; intermittent.

Mariana Creek.—Wilson County; rises west of Floresville in the central part of the county; flows into San Antonio River, thence to the Guadalupe.

Marion Creek.—Tarrant County; rises 9 miles northwest of Fort Worth; flows southeasterly into West Fork of Trinity River (tributary to the Trinity) at Fort Worth. Fort Worth topographic map.

Maritas Creek.—Webb County; small stream in southern part of county; unites with San Juanita Creek (tributary to Rio Grande); intermittent.

Marley Creek.—San Saba County; a stream in the southeastern part of county; flows 11 miles into Fall Creek (tributary to Colorado River). Llano and Burnet topographic maps.

Marshall Creek.—Mason and Llano counties; a stream 8 miles long flowing through the southwestern part of Llano and southeastern part of Mason County into Cold Spring Creek (tributary to Hickory Creek, and thus through Llano River to the Colorado). Mason and Llano topographic maps.

Martinez Creek.—Bexar County; rises northwest of the city of San Antonio; flows southeasterly 10 miles into San Pedro Creek (tributary to San Antonio River and thus to the Guadalupe) in the southwestern part of San Antonio. San Antonio topographic map.

Martin or Deep Creek.—Mason County; rises 3 miles north of Fly Gap in northwestern part of county; flows southeasterly 15 miles into Llano River (tributary to the Colorado) 1½ miles west of Castell; partially intermittent. Mason and Llano topographic maps.

Martinez Creek.—Bexar County; rises in the eastern part of the county; flows easterly 18 miles into Rio Cibolo and thus through San Antonio River to the Guadalupe. San Antonio topographic map.

MARTINS CREEK.—Comanche and Brown counties; rises at Prairie Gap in northern part of Brown County; flows northeasterly 22 miles into Copperas Creek (tributary through Leon and Little rivers to the Brazos) 7 miles southwest of De Leon; called Little Jimmys Creek above Sidney; passes through Sidney. Brownwood and Eastland topographic maps.

MARTINS CREEK.—Jack County; a stream flowing through northeastern part of county into West Fork of Trinity River and thus to the Trinity.

MARTINS CREEK.—Maverick and Webb counties; a small intermittent stream rising in the southern part of Maverick County and flowing southerly 4 miles into Rio Grande in the western corner of Webb County.

MARTIN BRANCH.—Johnson County; rises near Brushy Knob in western part of county; flows southwesterly 4 miles into Nolands River (which discharges into the Brazos), 3 miles southeast of Munroe. Cleburne topographic map.

MARTINS CREEK.—Roberts County; an intermittent stream rising in northwestern part of county and flowing southeasterly 7 miles into Canadian River (which discharges into the Mississippi through Arkansas River) 9 miles northeast of Peaceville in northwestern part of county.

MARTINS CREEK.—Rusk and Panola counties; rises about 4 miles northeast of Henderson in Rusk County; flows northeasterly 17 miles to the county line, then southeasterly 12 miles into Sabine River in northern part of Panola County about 5 miles southwest of Tacoma.

MARYS BAYOU.—Brazoria and Galveston counties; rises in northeastern corner of Brazoria County; flows southeasterly 1 mile through Brazoria County, then 2 miles through Galveston County into Clear Creek (thence to Galveston Bay and Gulf of Mexico) near Friendswood.

MARY CREEK.—Mills and Hamilton counties; a stream flowing southeasterly 6 miles into Lampasas River (tributary through Little River to the Brazos), 1 mile north of the village of McGirk. Hamilton topographic map.

MARYS CREEK.—Parker and Tarrant counties; rises about 6 miles north of Aledo in Parker County; flows southeasterly 15 miles into Clear Fork of Trinity River (tributary to West Fork of the Trinity and thus to Trinity River), 7 miles southwest of Fort Worth. Weatherford and Fort Worth topographic maps.

MASONS CREEK.—Bandera County; small stream northeast of Bandera in the eastern part of county; flows into Bandera Creek (tributary to Medina River, and thus through San Antonio River to the Guadalupe).

MASON CREEK.—Harrison County; rises in southwestern part of county; flows southeasterly 10 miles into Sabine River.

MASON CREEK.—Harris County; rises in southeastern part of county 2 miles northeast of Katy; flows southeasterly 6½ miles to a point near Buffalo Bayou, where its channel disappears; intermittent. Katy, Addicks, and Clodine topographic maps.

MASSIE CREEK.—Bowie County; about 2 miles west of Maginnis; small stream flowing into Caney Creek (tributary to Langum Creek, and thus through Sulphur and Red Rivers to the Mississippi); intermittent.

MATATE CREEK.—Atascosa County; a small tributary of La Parita Creek (thence to Nueces River through Atascosa and Frio rivers), in the southern part of the county; flows southeasterly 11 miles. Upper stream known as East and West Matate creeks.

MATHEWS BRANCH.—Parker County; rises near Center Mill; flows westward 2 miles into Brazos River in southern part of county. Weatherford topographic map.

Mavericks Creek.—Concho County; a stream 3 miles long flowing into Brady Creek (tributary to Colorado River and through the San Saba), northeast of Eden in the southeastern part of the county. Eden topographic map.

Maverick Creek.—Edwards and Uvalde counties; a small intermittent tributary to East Nueces River (tributary to Nueces River) in the southeastern part of Edwards County and northwestern part of Uvalde County; flows southeasterly; length [illegible] miles. Nueces topographic map.

Maxon Creek.—Brewster County; rises in eastern part; flows southeasterly into San Francisco Creek (tributary to Rio Grande); intermittent. Bullis Gap and Indian Wells topographic maps.

Mayhaw Bayou.—Jefferson County; rises 3 miles southeast of Winnie in western part of county; flows northeasterly [illegible] miles into Taylors Bayou (tributary through Sabine Lake to Gulf of Mexico) about 4½ miles southeast of Hampshire.

Maynard Creek.—Sutton and Kimble counties; rises in the southeastern part of Sutton County; flows northeasterly 15 miles into North Llano River (tributary through the Llano to Colorado River) 4 miles northeast of Patterson Ranch, Kimble County. Rock Springs topographic map.

McBees Creek.—Van Zandt County; small stream flowing northeasterly 12 miles into Sabine River in northwestern part of county.

McCann Branch.—Tarrant County; a small stream flowing into Indian Creek (which discharges through West Fork of Trinity River into the Trinity) north of Dido in the northwestern part of county. Fort Worth topographic map.

McClelland Creek.—Gray County; rises in southwestern part of county; flows easterly and northeasterly 29 miles into North Fork of Red River (tributary to Red River and thus to the Mississippi) in the eastern part of the county about 1 mile from eastern boundary.

McClain Canyon.—Terrell County; rises in southwestern part, 1½ miles north of McClain ranch; flows southwesterly 4½ miles into Sanderson Canyon (tributary to Rio Grande); intermittent. Dryden Crossing topographic map.

McClung Creek.—Fannin County; rises about 6 miles southwest of Bonham in western part of county; flows easterly 6 miles into Bois d'Arc Creek (tributary to Red River and thus to the Mississippi) about 4 miles south of Bonham.

McCormick Creek.—Donley County; a stream 7 miles long flowing easterly through eastern part of county into Salt Fork of Red River (tributary to Prairie Dog Town Fork of the Red and thus through Red River to the Mississippi).

McCormicks Lake.—Harris County; small lake 7½ miles southeast of Humble; three-tenths of a mile long and one-twentieth of a mile wide. Harmaston topographic map.

McCoy Creek.—Wise County; small stream flowing through northwestern part of county into West Fork of Trinity River (tributary to the Trinity).

McCoy Creek.—Dewitt County; in the northern part of county near Hochheim; small tributary to Queens Creek and thus to Guadalupe River.

McCullum Creek.—Armstrong and Donley counties; rises in eastern part of Armstrong County south of Goodnight; flows easterly 11 miles into Salt Ford of Red River (tributary to Prairie Dog Town Fork of Red River and thus through Red River to the Mississippi) in western part of Donley County near Armstrong-Donley county line.

McDonald Creek.—Crosby County; rises in southeastern part of county; flows easterly 14 miles into White River (tributary through Salt Fork of Brazos River to the Brazos) near Crosby-Dickens county line.

McDOWELL CREEK.—Stephens and Shackelford counties; rises south of Fat Top; flows southeasterly 5 miles into Hubbard Creek (tributary through Gonzales Creek to clear Fork of Brazos River and thus to the Brazos) in northwestern part of Stephens County. Albany topographic map.

McDONALDS CREEK.—Walker County; rises south of Huntsville; flows southwesterly 8 miles to its junction with West San Jacinto River (thence to San Jacinto River and Gulf of Mexico) near the southwestern county line.

McFARLAND CREEK.—Fannin County; small stream flowing southeasterly through southeastern part of county joining North Sulphur River (tributary to Sulphur River and thus through Red River to the Mississippi); length 5 miles.

McFARLAND LAKE.—Bowie County; this lake about 4 miles south of Maud in southern part of county formerly embraced the following lakes: Malden, Big. Dixon, Piney, and Spring, all of which are now connected by channels and formed by an old channel of Sulphur River (tributary to Red River, which discharges into the Mississippi). New Boston topographic map.

McGRAW CREEK.—Newton County; rises about 6 miles north of Burkeville; flows southeasterly 8 miles into Little Cow Creek (thence to Sabine River) about 2 miles southeast of Burkeville in northern part of county.

McGREW CREEK.—Hunt County; small stream flowing into Cedar Creek (tributary to Cowleach Fork of Sabine, thence to Caddo Fork of Sabine River and the Sabine) in south central part of the county.

McKENZIE CREEK.—Kent County; rises at McKenzie Mountain in southwestern part of county; flows northeasterly 10 miles into Double Mountain Fork of Brazos River (tributary to the Brazos).

McKENZIE CREEK.—Pecos County; rises about 18 miles southeast of Fort Stockton; flows easterly to its confluence with Pecos River (tributary to Rio Grande) 22 miles southeast of Fort Stockton; near old stage fort; springs supply a perennial flow which continues a distance of 3 or 4 miles then sinks in sand.

McKIM CREEK.—Sabine and Newton counties; headwater stream of Big Cow Creek (tributary to Sabine River).

McKIM CREEK.—Sabine County; flows westerly into Bear Creek (tributary to Ayish Bayou, and thus to Angelina and Neches rivers) in southwestern part of county; length, 6 miles.

McKINNEY BRANCH.—Erath County; small intermittent tributary to Bosque River 7 miles southeast of Alexander. Stephenville topographic map.

McKINNEY CREEK.—Bowie County; rises about 2 miles southwest of Leary; flows southeasterly 5 miles into Elliott Creek (tributary to Sulphur River and thus through Red River to the Mississippi) about 2 miles east of Redwater; intermittent. Texarkana topographic map.

McKINNEY LAKE.—Bowie County; about 7½ miles west of Index in northeastern part of county; formed by an old channel of Red River (tributary to the Mississippi); very small.

McLAUGHLIN CREEK.—Bastrop County; rises near McDade; flows westerly 4 miles into Big Sandy Creek and thus to Colorado River. Bastrop topographic map.

McNUTT CREEK.—Williamson County; small stream 4 miles long flowing southeasterly to a point 3 miles west of town of Hutto, where it enters Brushy Creek (tributary through San Gabriel River to Little River and thus to the Brazos). Georgetown topographic map.

MIDDLE BERNARD CREEK.—Wharton County; small stream in northern part of the county; flows easterly into Bernard River and thus to Gulf of Mexico.

MIDDLE BOSQUE RIVER.—McLennan and Coryell counties; rises near Turnersville in northern part of McLennan County; flows southeasterly 32 miles into South Bosque River (tributary to Bosque River and thus to the Brazos) in central part of McLennan County. Meridian, Temple, and Waco topographic maps.

MIDDLE BRANCH, CONCHO RIVER.—Reagan, Irion, and Tom Green Counties; rises southeast of Stiles in central part of Reagan County; flows easterly 14 miles through Reagan County, 26 miles through Irion County, then 16 miles through Tom Green County into South Concho River (tributary to the Concho and thus to Colorado River), 5 miles southwest of San Angelo in western part of Tom Green County. Sherwood topographic map. (See Concho River.)

MIDDLE FORK.—Johnson County; rises in southeastern part, 1 mile west of Stubblefield; flows southeasterly 7 miles into South Fork of Chambers Creek (tributary to Chambers Creek and thus to Trinity River). Cleburne topographic map.

MIDDLE FORK OF SULPHUR RIVER.—Fannin, Hunt, and Delta counties; rises in southern part of Fannin County; flows southeasterly 25 miles into South Sulphur River (tributary to Sulphur River, thence through Red River to the Mississippi) south of Klondike in southwestern part of Delta County.

MIDDLE FORK OF WICHITA RIVER.—King and Foard counties; rises in north central part of King County; flows northeasterly 27 miles into North Wichita River (tributary to Wichita River and thus through Red River to the Mississippi) in the southwestern part of Foard County.

MIDDLE KICKAPOO CREEK.—Concho County; southwest of Paint Rock in the western part of the county; flows 10 miles to its junction with Kickapoo Creek and thus through Concho River to the Colorado. San Angelo and Eden topographic maps.

MIDDLE MUSTANG CREEK.—Runnels County; small stream joining Mustang Creek (tributary to the Colorado) a mile southeast of Norwood in the southeastern part of the county; length, 11 miles. Ballinger topographic map.

MIDDLE MUSTANG CREEK.—Wharton County; small intermittent stream flowing southerly to its junction with East Mustang Creek (tributary to Mustang Creek, Navidad and Lavaca rivers, and Gulf of Mexico) near the center of the southwestern county line.

MIDDLE NOLAND CREEK.—Johnson County; rises 1½ miles southwest of Bruce in western part of county; flows southeasterly 6 miles to its junction with West Noland Creek to form Nolands River (tributary to the Brazos) 2 miles southeast of Munroe. Granbury and Cleburne topographic maps.

MIDDLE PEASE RIVER.—Motley and Cottle counties; rises about 9 miles southwest of Roaring Springs in southwestern part of Motley County; flows northeastward 63 miles into Pease River (tributary to Red River and thus to the Mississippi) about 5 miles north of Swearingen in northeastern part of Cottle County.

MIDDLE VALLEY.—Sutton and Schleicher counties; a long intermittent extension of San Saba River (tributary to the Colorado) in the southeastern part of Schleicher and northern part of Sutton County; unites with North Valley at Fort McKavett, forming San Saba River proper; length, 28 miles. Fort McKavett topographic map.

Middle Walnut Creek.—Falls and Robertson counties; rises in eastern corner of Falls County; flows southward 11 miles into Walnut Creek (tributary to Little Brazos River and thus to the Brazos) 4 miles south of Bremond.

Milam Creek.—Bowie County; an intermittent stream flowing northeasterly 5 miles into Langum Creek (tributary through Sulphur River to Red River and thus to the Mississippi) about 2 miles southeast of Redwater, in southern part of county. New Boston and Texarkana topographic maps.

Mill Branch.—Bowie County; small stream flowing into Big Creek (tributary to Red River and thus to the Mississippi) about 6 miles north of Texarkana Junction in northeastern part of county.

Mill Branch.—Palo Pinto County; rises 4½ miles southwest of Palo Pinto; flows northerly 3¾ miles into Eagle Creek (tributary to Brazos River). Palo Pinto topographic map.

Mills Branch.—Harris County; small intermittent stream rising in northeastern part of county 6¼ miles northeast of Moonshine Hill; flows northeasterly 1¼ miles into Whiteoak Creek, thence to Caney Creek, and thus through East Fork of San Jacinto River to Gulf of Mexico. Moonshine Hill topographic map.

Mills Branch.—Baylor County; a stream flowing southerly 9 miles into Brazos River near Baylor-Throckmorton county line southeast of Round Timber.

Mill Creek.—Angelina County; small stream flowing into Cypress Creek, thence to Neches River in southeastern part of county.

Mill Creek.—Austin County; formed by union of East and West Forks of Mill Creek, 4 miles west of the town of Bellville; flows southeasterly 15 miles into Brazos River 3 miles northwest of San Felipe.

Mill Creek.—Burnet and Bell counties; small stream flowing northeasterly 12 miles into Lampasas River (tributary through Little River to the Brazos) 1 mile southwest of Maxdale. Georgetown topographic map.

Mill Creek.—Cass County; rises about 3 miles northwest of Linden in central part of county; flows northeastward 4 miles into Frazier Creek (tributary to Caddo Lake and thus through Red River to the Mississippi) about 6 miles north of Linden.

Mill Creek.—Cass County; rises 4 miles west of Lanark in northeastern part of county; flows northwesterly 3 miles into Sulphur River (tributary through Red River to the Mississippi). Atlanta topographic map.

Mill Creek.—Cass County; rises about 1 mile west of Almira in western part of county; flows southwesterly 7 miles into Flat Creek (tributary through Black Cypress Bayou to Big Cypress Bayou and thus through Caddo Lake and Red River to the Mississippi) about 5 miles west of Linden.

Mill Creek.—Cass County; rises about 2 miles north of Marietta in northwestern part of county; flows northerly 5½ miles into Sulphur River (which discharges into the Mississippi through Red River) about 3 miles northeast of Jennings Lake Switch. Daingerfield topographic map.

Mill Branch.—Comanche County; small intermittent stream rising in the northeastern part of the county and flowing into Leon River (tributary to Little River and thus to the Brazos) southwest of Mount Airy. Stephenville topographic map.

Mill Creek.—Grayson County; small intermittent stream flowing into Red River (tributary to the Mississippi) near Locust in northern part of county. Denison topographic map.

Mill Creek.—Guadalupe County; rises in the Mill Creek Hills in the north central part of the county; flows southeasterly 11 miles into Guadalupe River about 13 miles southeast of Seguin. San Marcos topographic map.

Mill Creek.—Hill and Ellis counties; rises 2 miles southeast of Files Valley in northeastern part of Hill County; flows southeasterly and northeasterly 26 miles into Pecan Creek (tributary through Richland Creek to Trinity River) in southern part of Ellis County. Cleburne topographic map.

Mill Creek.—Grimes and Montgomery counties; rises in southeastern part of Grimes County; flows southeasterly 4 miles through Grimes County, then 13 miles through Montgomery County into Spring Creek (tributary to San Jacinto River, and thus to Galveston Bay and Gulf of Mexico).

Mill Creek.—Grayson County; rises 2 miles north of Pilot Grove; flows northerly 11 miles into Choctaw Creek (tributary to Red River and thus to the Mississippi) about 6 miles southeast of Denison.

Mill Creek.—Jasper County; small tributary to Neches River near Evadale.

Mill Creek.—Mason County; a stream 8 miles long flowing through central part of the county into Llano River (tributary to the Colorado). Mason topographic map.

Mill Creek.—Nacogdoches County; rises about 2 miles west of Bonito Junction; flows southeasterly 4 miles into Bayou Bonito (tributary to Bayou La Nana, thence to Angelina and Neches rivers) about one-half mile north of Nacogdoches.

Mill Creek.—Panola County; rises in southeastern part; flows southwesterly 7 miles; empties into Socagee Bayou (thence to Sabine River).

Mill Creek.—Shelby County; stream flowing into Patroon Bayou (tributary to Sabine River) southwest of Patroon in southeastern part of county.

Mill Creek.—Parker County; small tributary to Silver Creek (which discharges into Trinity River through the West Fork of the Trinity) southwest of Azle in the northeastern part of the county. Weatherford topographic map.

Mill Creek.—Shackelford County; rises 3 miles southeast of Antelope Hills in northern part of county; flows northeasterly 12 miles into Clear Fork of Brazos River (tributary to the Brazos) one mile east of Fort Griffin. Albany topographic map.

Mill Creek.—Taylor and Runnels counties; a stream flowing through the southeastern part of Runnels County, then southwest of Guion in the southern part of Taylor County into Bluff Creek and thus through Elm Creek into Colorado River; length, 10 miles. Abilene topographic map.

Mill Creek.—Titus County; in northern part; flows northwesterly 7 miles into Green Creek (tributary to Whiteoak Bayou, thence through Sulphur River to Red River and thus to the Mississippi).

Mill Creek.—Tyler County; rises about 4 miles southwest of Woodville; flows southeasterly 6 miles into Big Cypress Creek (tributary through Alabama Creek to Neches River).

Mill Creek, West Fork of.—Washington and Austin counties; rises 4 miles southwest of Burton in Washington County; flows southeasterly 25 miles to its junction with East Fork of Mill Creek forming Mill Creek (tributary to the Brazos), 4 miles west of Bellville.

Mill Creek, East Prong.—Bowie County; rises about 3 miles north of Oakgrove in southwestern part of county; flows northerly 4 miles into Mill Creek (tributary to Red River, which discharges into the Mississippi). At its mouth the stream expands into what is known as Phillips Marsh.

MILL CREEK.—Red River and Bowie counties; rises about a mile north of Avery in eastern part of Red River County; flows northeasterly and easterly 14 miles; unites with Red River (tributary to the Mississippi) about 10 miles north of De Kalb in northwestern part of Bowie County.

MILL CREEK, EAST FORK.—Washington and Austin counties; rises in the southwestern part of Washington County; flows southeasterly 26 miles to its junction with West Fork of Mill Creek, forming Mill Creek (tributary to the Brazos) 4 miles west of Bellville.

MILLS CREEK.—Burleson County; rises near Milam-Burleson county line; flows southerly 5 miles into First Yegua Creek (tributary through Yegua Creek to Brazos River).

MILL CREEK LAKE.—Bowie County; about 6 miles northwest of Oakgrove; an expansion of Mill Creek, which discharges into Red River (tributary to the Mississippi).

MILLER CREEK.—Edwards County; a small intermittent tributary to East Nueces River (thence to Nueces River) in the southern part of the county; length, 4 miles. Nueces topographic map.

MILLER CREEK.—Llano County; rises in northern part of county 5 miles northeast of Lone Grove; flows southerly 9½ miles into Llano River, and thus to the Colorado. Llano topographic map.

MILLER CREEK.—Uvalde County; small intermittent tributary to East Nueces River in western part of county. Bracket topographic map.

MILLERS OR PLUM CREEK.—Baylor, Throckmorton, and Haskell counties; rises 4 miles north of Haskell in center of Haskell County; flows northeasterly 35 miles into Brazos River, in southern part of Baylor County.

MILLERS CREEK.—Blanco County; rises about midway between Johnson City and Blanco, at an approximate altitude of 1,750 feet above mean sea level, in southern part of county; flows eastward and northward 18 miles to its junction with Pedernales River (tributary to Colorado River) 8 miles east of Johnson City. Blanco topographic map.

MILLERS CREEK.—Goliad County; small stream in southern part of county; flows southerly to its junction with Blanco Creek (thence to Gulf of Mexico through El Sarco River, Rio de la Mission, and Copano Bay).

MINE CREEK.—Leon County; a stream 4 miles long flowing westerly into Navasota River (tributary to Brazos River) near Billington.

MINERAL CREEK.—Robertson County; rises at Englewood in central part of county; flows northeasterly 9 miles into Duck Creek (tributary to Navasota River and thus to the Brazos) 2 miles northwest of Lake.

MINERAL CREEK.—Grayson County; formed about 2 miles north of Whitesboro in western part of county by union of North and South Branches of Mineral Creek; flows easterly and northerly 18 miles into Red River (tributary to the Mississippi) about 3 miles northeast of Cedar Mills in northern part of county. Denison topographic map.

MINERAL CREEK, SOUTH BRANCH OF.—Cooke and Grayson counties; rises 3 miles southwest of county line in eastern part of Cooke County; flows easterly 4 miles to its junction with the North Branch of Mineral Creek to form Mineral Creek (tributary to Red River and thus to the Mississippi) about 2 miles north of Whitesboro in western part of Grayson County. Denison topographic map.

MINERAL CREEK, NORTH BRANCH OF.—Cooke and Grayson counties; rises about 3 miles southwest of county line in eastern part of Cooke County; flows easterly 5 miles to its union with South Branch of Mineral Creek to form Mineral Creek (tributary to Red River and thus to the Mississippi) 2 miles north of Whitesboro in western part of Grayson County. Denison topographic map.

MINGUS LAKE.—Palo Pinto County; 2½ miles east of Strawn in southwestern part of county; on Palo Pinto Creek (tributary to Brazos River); very small. Palo Pinto topographic map.

MINITA CREEK.—Bexar County; rises 1 mile south of Espada Mission; flows into San Antonio River and thus to the Guadalupe; intermittent. San Antonio topographic map.

MINNEASOSA CREEK.—Hartley and Oldham counties; rises in eastern part of Union County, N. Mex., passes through extreme corner of Hartley County, Tex., and flows southeasterly 25 miles to a point 18 miles north of Adrian in western part of Oldham County, where it enters Canadian River and thus through Arkansas River to the Mississippi; intermittent.

MINNIE CREEK.—Donley and Collingsworth counties; rises in northeastern part of Donley County; flows southeasterly 7 miles into Salt Fork of Red River (tributary through Prairie Dog Town Fork of the Red to Red River and thus to the Mississippi) in Collingsworth County about a mile east of the western boundary of the county.

MINNIES CREEK.—Howard County; small stream in northeastern part of county; flows into Willies Creek and thus to the Colorado.

MINNIE CREEK.—Wilbarger County; rises in southeastern part; flows northeasterly 14 miles into Beaver Creek (tributary to Wichita River and thus through Red River to the Mississippi).

MIRASOL CREEK.—Duval and McMullin counties; rises in northern part of Duval County; flows northwestward 5 miles through Duval, then 9 miles through McMullen County into Nueces River in northwest part of county.

MISSION LAKE.—Calhoun County; a tidal lake in western part of the county formed by Guadalupe River.

MITCHELL BRANCH.—Mills County; a small stream rising northwest of Mullen in the northwestern part of the county; flows 2 miles into Pompey Creek and thus through Blanket Creek to Pecan Bayou (tributary to Colorado River). Brownwood topographic map.

MITCHELL CREEK.—Gonzales County; small intermittent stream east of the town of Gonzales in the eastern part of the county; flows into Peach Creek and thus to the Guadalupe. Flatonia topographic map.

MITCHELL CREEK.—Hopkins and Franklin counties; rises in northwestern part of Hopkins County; flows southeasterly 9 miles into Whiteoak Bayou (tributary to Sulphur River and thus to the Mississippi through Red River) in northwestern part of Franklin County.

MITCHELL CREEK.—Llano County; rises near Babyhead in northeastern part of county; flows southward 11 miles into Llano River (tributary to Colorado River), 3 miles east of the town of Llano; upper stream known as Wright Creek. Llano topographic map.

MIXONS CREEK.—Lavaca County; rises near Kinkler; flows southeastward 12 miles into Navidad River (tributary to Lavaca and thence to Gulf of Mexico through Matagorda Bay) 1 mile west of Sublime.

MONETO CREEK.—Hartley and Oldham counties; rises near line of Hartley and Oldham Counties; flows southeasterly 10 miles into Canadian River (tributary to Arkansas River and thus to the Mississippi) 8 miles west of Cheyenne in northern part of Oldham County; intermittent.

MONIA CREEK.—Hartley County; an intermittent stream rising in southern part of Union County, N. Mex., entering Hartley County, Tex., 10 miles west of Romero, and flowing southeasterly 15 miles into Maj. Longs Creek (tributary to Mustang Creek, thence through Canadian and Arkansas Rivers to the Mississippi) 5 miles east of Romero in western part of county.

MONTAGUE CREEK.—Cooke County; rises on Wolf Ridge; flows southeasterly 7 miles into Elm Fork of Trinity River (tributary to the Trinity) near Lindsey; intermittent. Gainesville topographic map.

MONTELL CREEK.—Uvalde County; a spring-fed tributary in the northwestern part of the county; flows southeasterly 9 miles to its junction with East Nueces River (thence to Nueces River) about 1 mile southwest of Montell. Nueces topographic map.

MONTGOMERY LAKE.—Dallam County; 9 miles east of New Mexico-Texas boundary line in southwestern part of county; outlet, Carrizo Creek; very small.

MOODYS CREEK.—Upshur and Gregg counties; rises in the southern part of Upshur County; flows southerly 6 miles into Sabine River in the northwestern part of Gregg County.

MOORE CREEK.—Comanche County; rises 1½ miles northeast of Mercers Gap in southern part of county; flows easterly into Mercer Creek (which discharges into Leon River, thence through Little River to the Brazos) 6 miles south of Comanche. Brownwood topographic map.

MOORE CREEK.—Wichita County; a stream 8 miles long rising in northwestern part of county and flowing into Red River, which discharges into the Mississippi.

MORGAN CREEK, SOUTH FORK.—Burnet County; rises about 4 miles southwest of Lake Victor in the northern part of the county; flows southwestward 8 miles into North Fork of Morgan Creek (tributary to Colorado River) near Baldy Mountain 3 miles east of Bluffton. Burnet topographic map.

MORGAN CREEK, NORTH FORK.—Burnet County; rises near Bunker Hill in the northern part of the county; flows southwesterly 10 miles into Colorado River 1 mile east of Bluffton. Burnet topographic map.

MORGAN CREEK.—Donley and Hall counties; rises in southern part of Donley County; flows southeasterly 11 miles into Indian Creek (tributary to Prairie Dog Town Fork of Red River and thus through the Red to Mississippi River) about 9 miles southwest of Memphis in northern part of Hall County.

MORGAN CREEK.—Howard and Mitchell counties; rises southeast of Luther in central part of Howard County; flows easterly 30 miles into Colorado River, 5½ miles southwest of the town of Colorado.

MORMAN CREEK.—Gillespie County; small stream southwest of Cherry Spring in the northern part of county; flows northwestward 6 miles into Beaver Creek (and thus through the Llano to Colorado River). Kerrville topograhpic map.

MORRIS CREEK.—Shelby County; small stream flowing into Sip Bayou (tributary to Sabine River) about 8 miles north of Hamilton in southeastern part of county.

MORRISS CREEK.—Harrison County; rises at Marshall in central part of county; flows northerly 11 miles into Little Cypress Bayou, thence to Caddo Lake and thus through Red River to the Mississippi.

MORRISON CREEK.—Caldwell County; southeast of Martindale; an intermittent stream flowing into San Marcos River (tributary to the Guadalupe). San Marcos topographic map.

MOSES BAYOU.—Galveston County; rises in central part of county; flows easterly 2 miles into Moses Lake (arm of Galveston Bay, and thence to Gulf of Mexico).

MOSS BRANCH.—Bastrop County; north of Caldwell, in the western part of the county; small intermittent tributary through Dry Creek to Colorado River; length, 4 miles. Bastrop topographic map.

[illegible] —[illegible] flows southwesterly 2 miles into [illegible] Creek [illegible] Creek to Sulphur River and [illegible] Red River to the Mississippi in southern part of county; [illegible] Boston [illegible] map.

[illegible] —[illegible] miles northwest of At[illegible] flows [illegible] into Butler Creek (tributary to Back [illegible] Red River to the Missis[illegible] about 4 miles [illegible] in northern part of county.

[illegible] —[illegible] and [illegible] counties; rises in northern part of [illegible] County; flows [illegible] 10 miles into [illegible] Creek and thus [illegible] River.

[illegible] —[illegible] and [illegible] counties; rises in northwestern part of [illegible] County 2 miles [illegible] of [illegible]; flows [illegible] along [illegible] County line [illegible] and [illegible] topographic maps.

[illegible] —[illegible] County; rises in west central part of county; flows [illegible] 6 miles into [illegible] Creek, tributary to West San Ja[illegible] River and [illegible] River [illegible] Gulf of Mexico.

[illegible] Creek.—Anderson County; a stream 4 miles long flowing south[illegible] into [illegible] Creek (tributary to Neches River) in central part of county.

[illegible] —[illegible] County; a small northeasterly flowing stream [illegible] Leon River (tributary through Little River to the Brazos) one [illegible] of [illegible] in northern part of county; length 7 miles. [illegible] topographic map.

[illegible] —Franklin County; small stream in southern part of county flowing [illegible] Big Cypress Creek (tributary to Caddo Lake, which dis[illegible] into the Mississippi through Red River).

[illegible] Creek.—Hall and Childress counties; rises in western part of Hall County; flows [illegible] Prairie Dog Town Fork of Red River (tributary to Red River, which discharges into the Mississippi) at [illegible] with eastern boundary of Hall and Childress counties.

[illegible] Creek.—Johnson, Ellis, Tarrant, and Dallas counties; rises about 2 miles [illegible] of Alvarado in central part of Johnson County; flows northeasterly 35 miles into West Fork of Trinity River (tributary to Trinity River) about 2 miles west of Eagleford. Cleburne, Fort Worth, and [illegible] topographic maps.

[illegible] Creek.—Kent County; rises in southern part; flows easterly 9 miles into Double Mountain Fork of Brazos River (tributary to the Brazos) [illegible] of H[illegible].

[illegible] Creek.—Montague and Cooke counties; rises about 1 mile northeast of Saint Jo in eastern part of Montague County; flows northeasterly 11 miles into Red River (tributary to Mississippi River) in extreme north[illegible] part of Cooke County about 2 miles northwest of Bulcher. Montague and Gainesville topographic maps.

[illegible] Creek.—Stonewall County; rises in southwestern part of county; flows southerly 10 miles into Double Mountain Fork of Brazos River (tributary to the Brazos).

[illegible] Creek.—Wise County; small stream flowing into West Fork of Trinity River (tributary to the Trinity) in western part of county.

[illegible] Creek.—Goliad County; small stream flowing southward in the southern part of the county to its junction with Blanco Creek, thence to Gulf of Mexico through El Sarco River, Rio de la Mission, and Copano Bay.

MUD BAYOU.—Jefferson and Chambers counties; rises in the southwestern corner of Jefferson County; flows southwesterly 6 miles to its junction with Elm Bayou (thence to Gulf of Mexico through Mud Bayou, East Bay Bayou, and East Galveston Bay) in the southeastern corner of Chambers County.

MUD CREEK.—Bowie County; rises about 4 miles northwest of Oak Grove in the northwestern part of county; flows easterly 19 miles into Red River (which discharges into the Mississippi) about 7½ miles northeast of Malta.

MUD CREEK, NORTH PRONG OF.—Bowie County; rises about 5 miles north of DeKalb in northern part of county; flows easterly 7 miles into Mud Creek (tributary to Red River and thus to the Mississippi).

MUD CREEK, SOUTH PRONG.—Bowie County; rises about 1½ miles northwest of Malta in northern part of county; flows northeasterly 5½ miles into Mud Creek (tributary to Red River, which discharges into the Mississippi).

MUD CREEK.—Brown and Coleman counties; rises northeast of Santa Anna; flows through the western part of Brown and eastern part of Coleman counties into Jim Ned Creek and thus through Pecan Bayou to Colorado River; length, 10 miles. Coleman topographic map.

MUD CREEK.—Cherokee County; formed about 2 miles west of Gould in northern part of county by the union of its east and west forks; flows southeasterly 24 miles into Angelina River (tributary to Neches River) about 4 miles southeast of Reklaw.

MUD CREEK.—Kinney County; rises about 6 miles northeast of Amanda; flows southwesterly 17 miles into Sycamore Creek (tributary to Rio Grande).

MUD CREEK.—Parker County; a stream 3 miles long flowing southwestward into Brazos River, northwest of Center Mill in southern part of county. Weatherford topographic map.

MUD CREEK.—Runnels County; rises north of Norwood in the eastern part of the county; flows 11 miles through Elm Creek and thus to the Colorado. Ballinger topographic map.

MUD CREEK, EAST FORK.—Smith and Cherokee counties; rises about 10 miles northeast of Tyler in Smith County; flows southwesterly 28 miles to its union with West Fork of Mud Creek about 2 miles west of Gould in northern part of Cherokee County.

MUD CREEK, WEST FORK.—Smith and Cherokee Counties; rises 2 miles south of Tyler in Smith County; flows southeasterly 23 miles to its confluence with East Fork of Mud Creek forming Mud Creek (tributary to Angelina and Neches rivers) about 2 miles west of Gould in northern part of Cherokee County.

MUD OR MERIWEATHER CREEK.—Upshur and Marion counties; rises about 3 miles west of Coffeeville in northeastern part of Upshur County; flows eastward into Big Cypress Bayou (tributary to Caddo Lake and thus through Red River to the Mississippi) at the northwestern boundary of Marion County; length, 9 miles.

MUDDY CREEK.—Collin and Dallas counties; rises one mile northwest of Wylie in Collin County; flows southeasterly 12 miles into Rowlett Creek (tributary to East Fork of the Trinity, thence to Trinity River) about three miles northwest of Barnes Bridge in northeastern part of Dallas County. Dallas and Rockwall topographic maps.

MUDDY CREEK.—Robertson County; rises about one mile west of the village of Franklin; flows southwesterly 12 miles into Little Brazos River (tributary to Brazos River) 4 miles north of Hearne.

[illegible] Creek.—[illegible] County; small stream flowing easterly 4 miles into [illegible] (tributary to Brazos River) [illegible] miles southeast of [illegible] in [illegible] part of county.

[illegible]—Harris County; small [illegible] 2 miles southeast of Humble; [illegible] topographic map.

[illegible] Creek.—[illegible], [illegible], and [illegible] counties; small [illegible] tributary to [illegible] Creek (thence to the Nueces through [illegible] and [illegible]) in [illegible] of [illegible], [illegible], and [illegible] counties; [illegible] miles. [illegible] map.

[illegible] Creek.—[illegible] County; small tributary to Chiltipin Creek (thence to [illegible] through [illegible] Creek, [illegible] Creek, and [illegible]) in [illegible] part of county.

[illegible] Creek.—[illegible] County; [illegible] stream in northeastern [illegible] of county; flows [illegible] into Brazos River.

[illegible] Creek.—[illegible] County; rises 1 mile [illegible] of Adrian; flows northwest- [illegible] tributary through the Canadian to Arkansas River and thence to the Mississippi) [illegible] miles northwest of Adrian, in western part of county. [illegible]

[illegible] Creek.—[illegible] County; small stream in northeastern part of county; flows [illegible] miles to its junction with [illegible] Creek (tributary to the Nueces).

[illegible] Creek.—[illegible] County; flows through [illegible], in the south-eastern part of the county, into [illegible] Creek (tributary to Colorado River); length 2 miles. [illegible] topographic maps.

[illegible] Creek.—[illegible] County; small stream in northeastern part of the county; flows [illegible] to its junction with Elm Creek (tributary to the Nueces), in northeastern part of county. [illegible] topographic map.

[illegible] Lake.—Armstrong County, northwestern part; an expansion of Mulberry Creek (tributary to Prairie Dog Town Fork of Red River and thence to the Red and Mississippi Rivers); area about three-fourths square mile.

[illegible] Creek.—Armstrong, Donley, Briscoe, and Hall counties; rises in the [illegible] part of Armstrong County near western county line; flows southeasterly 62 miles into Prairie Dog Town Fork of Red River (tributary to Red River and thus to the Mississippi), in northwestern part of Hall County.

[illegible] Creek.—Fayette County; rises 2 miles south of Flatonia; flows easterly 12 miles into West Fork Navidad River (which discharges into Lavaca River through the Navidad and thence to Matagorda Bay and Gulf of Mexico), near the Lavaca-Fayette county line. Flatonia topographic map.

Mulberry Creek.—Fayette and Lavaca counties; rises near Flatonia, in the southern part of Fayette County; flows southeasterly to its junction with Navidad River (tributary to Lavaca River and thus to Gulf of Mexico) near Oakland, in the northern part of Lavaca County. Flatonia topographic map.

Mulberry Creek.—Jones, Nolan, and Taylor counties; rises in Mulberry Canyon north of Nolan, in eastern part of Nolan County; flows northeasterly 36 miles into Clear Fork of Brazos River (tributary to the Brazos) near McCaulley, in southeastern part of Jones County. Sweetwater, Abilene, and Anson topographic maps.

Mulberry Creek.—Lamar County; rises about 2 miles west of Blossom; flows southerly 11 miles into Little Sandy Creek (tributary to Sulphur River and thus through Red River to the Mississippi).

MULBERRY CREEK.—Sterling and Tom Green counties; rises in the southeastern part of Sterling County; flows northeastward into North Concho River (tributary to the Colorado through Concho River), in the northwestern corner of Tom Green County.

MULE CREEK.—Coke and Runnels counties; rises in southeastern part of Coke County; flows northeastward 14 miles into Colorado River 4 miles south of Maverick in western part of Runnels County. Hayrick topographic map.

MULE CREEK.—Foard County; rises about 2 miles southwest of Margaret, in northeastern part of county; flows easterly 6 miles into Pease River (tributary to Red River and thus to the Mississippi) about 3 miles east of Margaret.

MULE CREEK.—Haskell County; rises 5 miles southwest of Haskell; flows southeasterly 11 miles to its junction with Paint Creek (tributary to California Creek, thence through Clear Fork of Brazos River to the Brazos), in southern part of county.

MULE CREEK.—Maverick County; an intermittent stream rising in the southern part of the county and taking a southwestern course 6 miles to its junction with Willow Creek (tributary to Rio Grande).

MULLEN CREEK.—Mills County; rises near the central part of county; flows into Brown Creek and thus through Pecan Bayou to the Colorado; length, 15 miles. Brownwood and San Saba topographic maps.

MURCHISON CREEK.—Van Zandt and Henderson counties; rises in southeastern part of Van Zandt County; flows southerly 10 miles into Kickapoo Creek (tributary to Neches River), in the northeastern part of Henderson County.

MURPHYS CREEK.—Shackleford County; a small stream flowing 5 miles northeasterly into Foyle Creek (tributary to Clear Fork of Brazos River and thus to the Brazos) one mile above mouth of Foyle Creek. Albany topographic map.

MURVALLS BAYOU.—Rusk and Panola counties; rises about 3 miles southwest of Long Branch in Rusk County; flows northeasterly 27 miles into Sabine River about 4 miles southwest of Deadwood.

MUSCLE CREEK.—Clay and Jack counties; rises in the southern part of Clay County; flows southerly 10 miles into West Fork of Trinity River (which discharges into the Trinity) about 9 miles north of Jacksboro in Jack County.

MUSQUIZ CANYON.—Presidio, Jeff Davis, and Brewster counties; rises about 12 miles northeast of Marfa in northeastern corner of Presidio County on northern slope of the Puertacitas Mountains at an approximate altitude of 5,200 feet above sea level; flows northeasterly 6 miles into Jeff Davis County, where it continues its course 6 miles, thence southward 4 miles, then eastward 7 miles into Brewster County uniting with Paisano Creek (tributary through Pecos River to Rio Grande) 15 miles northeast of Alpine. Alpine and Fort Davis topographic maps.

MUSTANG BAYOU.—Brazoria County; rises 2 miles east of Manvale in northeastern part of county; flows southeasterly 21 miles into West Galveston Bay, and thus to Gulf of Mexico.

MUSTANG BRANCH.—Hays County; an intermittent stream in the northeastern part of the county; flows northeastward 8 miles to its junction with Onion Creek (tributary to Colorado River) 2 miles southwest of Buda. Austin topographic map.

MUSTANG CREEK.—Bosque County; rises in southwestern part of county 11 miles southwest of Meridian; flows southeasterly 7 miles into Meridian Creek (tributary to Bosque River); intermittent. Meridian topographic map.

[illegible] rises in the southwestern [illegible] Lipan and East [illegible] Bosque River and thence to the Brazos [illegible] part of Bosque County. Granbury topographic [illegible].

[illegible] rises 2 miles west of [illegible] flows southwestward [illegible] Ballinger in the northeastern [illegible].

[illegible] rises in southwestern part of county; [illegible] River [illegible] through Little River [illegible] Hamilton topographic [illegible].

[illegible] rises 7 miles north of Eden in Brady [illegible] at approximate altitude of 2,300 [illegible] miles into Concho River [illegible] county. Eden topographic map.

[illegible] counties; rises at [illegible] flows southeasterly and [illegible] miles through Wharton [illegible] county into Navidad River [illegible] and Gulf of Mexico [illegible] Wharton county line the [illegible].

[illegible] rises 3 miles south of [illegible] flows southeasterly 25 miles into [illegible] Little River [illegible] the Brazos 5 miles northwest [illegible] topographic maps.

[illegible] rises near Clayton [illegible] the State of Texas [illegible] counties [illegible] River and thus to the [illegible] northeastern part of Oldham [illegible].

[illegible] Little Elm Creek (which [illegible] the Elm Fork of the Trinity) in [illegible].

[illegible] in the southwestern [illegible] through Dewitt [illegible] enters Ecleto Creek [illegible] near Helena.

[illegible] Waxahachie Creek [illegible] Creek to Trinity [illegible].

[illegible] about a mile east of Whitesboro in [illegible] miles into Mineral Creek [illegible] about 2 miles northeast [illegible].

M[illegible] rises about 2 miles east of [illegible] 25 miles into Rock Creek [illegible] the West Fork of the [illegible] Benbrook in the [illegible] and Fort Worth [illegible].

MUSTANG CREEK.—Johnson and Hill counties; rises near Cuba in southern part of Johnson County; flows southwesterly 13 miles into Nolands River (tributary to Brazos River) 2 miles north of Blum in northwestern part of Hill County. Cleburne topographic map.

MUSTANG CREEK.—Kaufman County; joins Cedar Creek (tributary to Trinity River) south of the town of Kaufman in central part of county.

MUSTANG CREEK.—Lavaca County; formed 2 miles north of Sweet Home by the union of the North and South forks of Mustang Creek; flows easterly 7 miles into Rocky Creek (tributary to Lavaca River, Matagorda Bay, and Gulf of Mexico) 6 miles south of Hallettsville.

MUSTANG CREEK, NORTH FORK.—Lavaca County; rises in southwestern part of county; flows easterly 3 miles to confluence with South Fork Mustang Creek forming Mustang Creek (which discharges into Lavaca River, then through Rocky Creek into Matagorda Bay, and thus to Gulf of Mexico) 2 miles north of Sweet Home.

MUSTANG CREEK, SOUTH FORK.—Lavaca County; rises 5 miles northwest of Yoakum; flows easterly 7 miles to its junction with the North Fork Mustang Creek to form Mustang Creek (which discharges into Lavaca River, Matagorda Bay, and Gulf of Mexico through Rocky Creek) 2 miles north of Sweet Home.

MUSTANG CREEK.—Leon County; about 3 miles west of Keechi; small tributary to Buffalo Creek, thence through Upper Keechi Creek to Trinity River.

MUSTANG CREEK.—Uvalde and Zavalla counties; rises in the southwestern part of Uvalde County; flows southeasterly 4 miles through Uvalde County, then 10 miles through Zavalla County to its junction with Nueces River near Lapryor in the northwestern part of Zavalla County; intermittent. Uvalde topographic map.

MUSTANG CREEK.—Williamson County; rises 3 miles northeast of Hutto; flows southeasterly 15 miles south of Taylor into Brushy Creek (tributary to San Gabriel River and thus through Little River to the Brazos) 7 miles southeast of Taylor. Georgetown and Taylor topographic maps.

MUSTANG CREEK.—Wilson and Karnes counties; small stream flowing through northeastern part of Wilson and northwestern part of Karnes counties into Elm Fork of Sandies Creek (tributary to Sandies Creek and thus to Guadalupe River).

MUTE BRANCH.—Hood County; a stream 3 miles long flowing southeasterly into Robinson Creek (tributary to Brazos River) in northwestern part of county. Granbury topographic map.

MYER BRANCH.—Grayson County; a small intermittent stream flowing to Harris Creek (tributary to Mineral Creek and thus through Red River to the Mississippi) near Steedman in northwestern part of county. Denison topographic map.

NABORS CREEK.—Mills County; a small stream 7 miles long flowing 5 miles southeast of Big Valley in the southern part of the county, and emptying into the Colorado. San Saba topographic map.

NACONICHI BAYOU.—Nacogdoches County; rises in the northern part of the county; flows southeasterly 18 miles into Attoyac Bayou (tributary to Angelina and Neches rivers).

NACOSTE CREEK.—Nacogdoches County; small stream flowing southerly 8 miles into Bayou Loco (tributary to Angelina River and thus to the Neches) in western part of county.

NANCY BRANCH.—Leon County; a small stream flowing southward 1½ miles into Birch Creek (tributary of Navasota River and thus to the Brazos) west of Jewett in western part of county.

NASH CREEK.—Guadalupe County; rises near Kingsbury; flows southeasterly 11 miles into Guadalupe River 2½ miles west of Belmont near its intersection with the county line; intermittent. San Marcos topographic map.

NASH CREEK.—Eastland County; rises near Carbon in southern part of county; flows easterly 13 miles into Leon River (tributary through Little River to the Brazos) 5 miles northwest of Desdimonia. Eastland topographic map.

NAVASOTA RIVER.—Hill, Limestone, Robertson, Leon, Madison, Brazos, and Grimes counties; rises in the southwestern part of Hill County; flows southeasterly 45 miles, then southerly 80 miles along county boundaries to Old Washington on the Brazos, where it enters Brazos River 5 miles southwest of Navasota. Navasota topographic map.

NAVIDAD RIVER.—West Fork; Lavaca and Fayette counties; rises 8 miles north of Schulenburg; flows southeasterly 17 miles into Navidad River (tributary to Lavaca River, and thus to Matagorda Bay and Gulf of Mexico) in northeastern corner of Lavaca County.

NAVIDAD RIVER.—Fayette, Colorado, Lavaca, and Jackson counties; rises 2 miles northeast of Schulenburg in southeastern part of Fayette County; flows southerly and southeasterly 4 miles through Fayette County, 5 miles along the boundary between Colorado and Lavaca counties, 30 miles through Lavaca County, then 22 miles through Jackson County to its junction with Lavaca River (and thus to Gulf of Mexico through Matagorda Bay) 3½ miles north of Vanderbilt.

NEBBLETTS CREEK.—San Jacinto County; small stream in southwestern part of the county; flows southeasterly to its junction with Winter Creek (tributary to East San Jacinto River, thence through San Jacinto River to Gulf of Mexico).

NECHES RIVER.—Rises about 12 miles southeast of the town of Canton in Van Zandt County in the northeastern part of the State; flows southeasterly 260 miles, enters Sabine Lake (which discharges into Gulf of Mexico through Sabine Pass) between Jefferson and Orange counties about 16 miles southeast of Beaumont. The river has a number of tributaries, the principal one being Angelina River. Gaging station at Evadale (1904–1906). The basin is heavily wooded, and contains a number of small power sites which do not materially affect the flow; rice is irrigated in lower portion of the drainage; rainfall abundant; drainage area, 10,100 square miles. See Second Report of Texas Board of Water Engineers for list of certified filings for appropriation of water.

NEDS CREEK.—Borden County; rises in eastern part of county; flows southward 6 miles into North Fork of the Colorado (tributary to Colorado River).

NEEDMORE CREEK.—Hemphill County; an intermittent stream 5 miles in length flowing north into Canadian River (tributary to Arkansas River and thus to the Mississippi) 10 miles southeast of Canadian in central part of county.

NEGRO CREEK.—Houston County; a stream 8 miles long, flowing into Trinity River south of Weldon in the extreme southern corner of the county.

NEIL CREEK.—Bosque County; formed in southern extremity of the county by union of the North and Middle forks of Neil Creek; flows easterly 16 miles into Bosque River (tributary to Brazos River) 6½ miles southeast of Clifton. Meridian topographic map.

NEIL CREEK, NORTH FORK.—Bosque and Hamilton counties; flows southeasterly 10 miles where it joins the Middle Fork of Neil Creek forming Neil Creek (tributary to Bosque River and thus to the Brazos) 4½ miles southeast of Cranfills Gap in southern part of Bosque County; intermittent. Meridian topographic map.

NEIL CREEK, SOUTH FORK OF.—Bosque and Hamilton counties; an intermittent stream flowing northeasterly 9 miles into Neil Creek (tributary to Bosque River and thus to the Brazos) 5 miles southeast of Cranfills Gap in southern part of Bosque County. Meridian topographic map.

NEIL CREEK, MIDDLE FORK.—Bosque and Hamilton counties; flows easterly 7 miles to its junction with the North Fork of Neil Creek forming Neil Creek (tributary to Bosque River and thus to the Brazos) 4½ miles southeast of Cransfills Gap in southern part of Bosque County; intermittent. Meridian topographic map.

NELSONS CREEK.—Walker County; rises northwest of Huntsville in the west central part of the county; flows northeasterly 18 miles into Trinity River south of Kittrell.

NEVICE CREEK.—Oldham County; rises in southern part of Union County, N. Mex.; flows southeasterly into western part of Oldham County, Tex., uniting with Canadian River (tributary to Arkansas River and thus to the Mississippi) 18 miles south of State Line.

NEWMAN CREEK.—King County; rises in east central part; flows northeasterly 7 miles into South Wichita River, tributary to Wichita River and thus through the Red to Mississippi River.

NEWTON CREEK.—Dallas County; small stream flowing into Fivemile Creek (tributary to Trinity River) west of Hutchins in south central part of the county. Dallas topographic map.

NEW YEARS CREEK.—Washington County; rises 5 miles southwest of Gay Hill; flows southeasterly 25 miles into Brazos River, 5 miles east of Chappel Hill in southeastern part of county.

NICHOLS CREEK.—Jasper and Newton counties; rises in south central part of Jasper County; flows southeasterly 27 miles into Sabine River about 8 miles north of Deweyville in southern part of Newton County.

NICHOLSON CREEK.—Stonewall County; small intermittent stream rising in southwestern part of county and flowing easterly into Double Mountain Fork of Brazos River (tributary to Brazos River). Roby topographic map.

NIGGER BRANCH.—Travis County; a small stream flowing into Cow Creek and thus to Colorado River in the northwestern part of the county; length, 4 miles. Burnet topographic map.

NIGGER CREEK.—Stephens County; rises at Flat Top; flows southeasterly 7 miles into Hubbard Creek (tributary through Gonzales Creek to Clear Fork of Brazos River and thus to the Brazos) in northwestern part of county. Albany topographic map.

NIGGER HOLLOW.—Bexar County; small intermittent stream southeast of Sayers, in the eastern part of county; joins Chupaderas Creek (tributary to Calaveras Creek, and thus through San Antonio River to the Guadalupe). San Antonio topographic map.

NOBLES CREEK.—Lamar County; rises about 1 mile west of Petty in southwestern part of county; flows southeasterly 9 miles into North Sulphur River (tributary to Sulphur River, and thus through Red River to the Mississippi) at the southern boundary of the county.

NOLANDS CREEK.—Bell County; formed 3 miles northwest of Belton in central part of county by union of North and South Noland Creek; flows southeastward 6 miles into Leon River (tributary to Little River, and thus to the Brazos) 2½ miles southeast of Belton. Gatesville and Temple topographic maps.

NOLANDS RIVER.—Hill and Johnson counties; formed 2 miles southeast of Munroe in western part of Johnson County by the confluence of West and Middle Noland Creeks; flows southerly 30 miles into Brazos River 2½ miles northeast of Kopperl in northwestern part of Hill County. Cleburne topographic map.

NOLTON CREEK.—Uvalde County; small intermittent stream in the northeastern part of the county; flows in a southeasterly direcion to its junction with Sabinal River (tributary to the Nueces through Frio River) in southeastern part of county. Uvalde topographic map.

NOODLE CREEK.—Jones and Taylor counties; an intermittent stream rising south of Trent near Nolan-Jones county line and flowing northeasterly 20 miles into Clear Fork of Brazos River (tributary to the Brazos) 5 miles west of Newsom in western part of Jones County. Sweetwater and Roby topographic maps.

NORIACITAS CREEK.—Webb and Jim Hog counties; small intermittent stream rising in the southeastern corner of Webb County; flows southeastward 13 miles to its junction with Arroyo del los Angeles forming Palo Blanco Creek (tributary to Gulf of Mexico through Laguna Madre).

NORTON CREEK.—Hopkins County; rises in southern part; flows southerly 5 miles into Burke Creek (tributary to Lake Fork of Sabine River, thence to the Sabine).

NORTH CREEK.—Jack County; rises about 9 miles west of Jacksboro; flows northeasterly 14 miles into West Fork of Trinity River (tributary to the Trinity) 7 miles north of Jacksboro.

NORTH CREEK.—Kerr and Kendall counties; rises in the northeastern corner of Kerr County; flows southerly 8 miles into Cypress Creek (tributary to Guadalupe River) near Comfort. Fredericksburg topographic map.

NORTH CREEK.—Leon County; stream 5 miles long flowing into Upper Keechi Creek (tributary to Trinity River) in northeastern part of the county.

NORTH BINGHAM CREEK.—Montague County; small intermittent stream flowing into Bingham Branch (tributary through Clear Creek to Elm Fork of Trinity River, thence to the Trinity) southeast of Forestburg. Montague topographic map.

NORTH COW BAYOU.—McLennan and Falls counties; rises 7 miles west of Lorena in southern part of McLennan County; flows southeasterly 15 miles to its junction with South Cow Bayou, forming Cow Bayou (tributary to Brazos River) 1 mile north of Mooresville, in western part of Falls County. Temple topographic map.

NORTH CEDAR CREEK.—Trinity County; a stream flowing easterly into Cedar Creek (tributary to Neches River) in northeastern part of county; length, 11 miles.

NORTH CORRAL CREEK.—Collingsworth County; a stream 2 miles long rising in northeastern part of county and flowing northeasterly into Elm Fork of Red River (tributary through North Fork of Red River to Red River and thus to the Mississippi).

NORTH COTTONWOOD CREEK.—Armstrong County; southeastern part; a southeastward flowing headwater stream of Cottonwood Creek (tributary to Mulberry Creek and thus through Prairie Dog Town Fork of Red River and Red River to the Mississippi); length, 4 miles.

NORTH CONCHO RIVER.—Formed by several indeterminate channels rising in the western part of Gaines and Andrews counties; flows in a southeasterly direction 35 miles through Martin County, 6 miles through Midland County, 30 miles through Glasscock County, 33 miles through Sterling County, 3 miles through Coke County, then 30 miles through Tom Green County to the city of San Angelo, near center of Tom Green County, where it unites with the South Concho to form Concho River (tributary to the Colorado); intermittent; area of drainage basin, 7,530 square miles. Gaging station at San Angelo. Sherwood and San Angelo topographic maps. (See Concho River).

NORTH ELM CREEK.—Falls and Milam counties; rises near Falls-Bell county line 11 miles east of Temple; flows southeasterly 13 miles into Elm Creek (tributary to Little River and thus to the Brazos) in northwestern part of Milam County. Temple topographic map.

NORTH ELM CREEK.—Wheeler and Collingsworth counties, Tex., and Beckham County, Okla.; rises in southeastern part of Wheeler County; flows southeasterly 5 miles across northeastern corner of Collingsworth County to its intersection with the Texas-Oklahoma boundary line, then takes a southerly course through Beckham County, Okla., and enters Elm Fork of Red River (tributary to North Fork of Red River and thus through the Red to Mississippi River).

NORTH FISH CREEK.—Cooke County; rises about 3½ miles east of Bulcher in northern part of county; flows southeasterly 10 miles to its junction with South Fish Creek to form Fish Creek (tributary to Red River and thus to the Mississippi) 6½ miles east of Marysville. Gainesville topographic map.

NORTH FORK OF CANADIAN RIVER.—Dallam and Sherman counties; enters Texas near northwestern corner between Dallam and Sherman counties; flows easterly 15 miles through northern part of Sherman County into Oklahoma at a point 10 miles west of Texhoma; unites with Canadian River (tributary to Arkansas River and thus to the Mississippi) in eastern part of Oklahoma.

NORTH FORK.—Lavaca County; small intermittent stream in northwestern corner of county; flows southerly 6 miles to its junction with Lavaca River, and thus to Matagorda Bay and Gulf of Mexico. Flatonia topographic map.

NORTH FORK.—Shackelford County; rises 8 miles northwest of Albany; flows southeasterly 12 miles into Hubbard Creek (tributary to Gonzales Creek, thence to Clear Fork of the Brazos and thus to Brazos River). Albany topographic map.

NORTH FORK.—Williamson and Bell counties; rises 4½ miles northeast of Florence; flows northeasterly 6½ miles into Salado Creek (tributary to Lampasas River and thus to Little River). Georgetown topographic map.

NORTH FORK OF RED RIVER.—Gray and Wheeler counties; rises west of Lefors in western part of Gray County; flows southeasterly 60 miles to Texas-Oklahoma boundary line about 4 miles north of Texola in southeastern part of Wheeler County, then southeasterly 120 miles through Oklahoma to its junction with Prairie Dog Town Fork of Red River to form Red River (tributary to the Mississippi) about 2 miles east of Doans, Wilbarger County, Tex.

NORTH GRAPE CREEK.—Gillespie and Blanco counties; rises 8 miles northeast of Fredericksburg in the northeastern part of Gillespie County; flows easterly 16 miles through that county, then 9 miles through Blanco County into Pedernales River (tributary to the Colorado) 4½ miles northwest of Johnson City. Fredericksburg and Blanco topographic maps.

North Llano River.—Sutton and Kimble counties; rises in the west central part of Sutton County at approximate altitude of 2,300 feet above sea level; flows in an easterly direction 25 miles through Sutton County, then 15 miles through Kimble County to its union with South Llano River, forming Llano River (tributary to the Colorado) at Junction in the central part of Kimble County; drainage area, 803 square miles. Gaging station near Junction. Fort McKavett topographic map. (See Llano River.)

North Mesquite Creek.—Dallas County; rises about 1 mile northwest of New Hope; flows southeasterly 10 miles into East Fork of Trinity River (tributary to Trinity River) 3 miles northeast of Haughts store. Dallas and Barnes Bridge topographic map.

North Noland Creek.—Bell County; rises 2 miles south of Brookhaven; flows southeasterly 10 miles to its junction with South Noland Creek forming Noland Creek (tributary to Leon, Little, and Brazos rivers) 3 miles northwest of Belton. Gatesville topographic map.

North Paluxy Creek.—Erath County; rises 3 miles southeast of Wileyville in northern part of county; flows easterly 18 miles to a point 1 mile west of Bluff Dale, where it unites with South Paluxy Creek to form Paluxy Creek (tributary to Brazos River). Stephenville topographic map.

North Palo Pinto Creek.—Palo Pinto, Stephens, and Eastland counties; rises 1½ miles south of Ranger, in northern part of Eastland County; flows northeasterly 21 miles to its junction with South Palo Pinto Creek to form Palo Pinto Creek (tributary to Brazos River) at Mingus, in southwestern part of Palo Pinto County. Eastland, Breckenridge, and Palo Pinto topographical maps.

North Prong.—Archer County; headwater stream of West Fork of Trinity River (tributary to Trinity River), south of Westfork, in southern part of the county.

North Rocky Creek.—Burnet County; rises 3 miles north of Sunnylane, in northeastern part of county; flows easterly 10 miles to its junction with South Rocky Creek to form Rocky Creek (tributary through Lampasas and Little rivers to the Brazos). Burnet and Georgetown topographic maps.

North Sulphur River.—Fannin, Lamar, Delta, and Hopkins counties; rises about 8 miles south of Bonham, in southern part of Fannin County; flows easterly 50 miles to its union with South Sulphur River to form Suphur River (tributary to Red River and thus to the Mississippi) at the corner of Lamar, Delta, and Hopkins counties, 4 miles northeast of Sulphur Bluff.

North Valley.—Schleicher County; an intermittent stream in the southeastern part of the county; connects with Middle Valley at Fort McKavett, forming San Saba River proper (tributary to the Colorado); length, 28 miles. Fort McKavett topographic map.

North Wichita River.—Motley, Dickens, King, Cottle, Foard, Knox, and Baylor counties; rises in southeastern corner of Motley County, takes an easterly course to its junction with South Wichita River to form Wichita River (tributary to Red River and thus to the Mississippi) northwest of Seymour, in northwestern part of Baylor County; length, 75 miles; head stream known locally as Buford Creek.

North Wichita River, North Fork of.—Dickens County; rises in northeastern part; small headwater stream of North Wichita River (tributary to Wichita River and thus through Red River to the Mississippi).

North Wichita River, South Fork of.—Dickens County; rises in northeastern part; small headwater stream of North Wichita River (tributary to Wichita River, which discharges into Mississippi River through the Red).

North Willow Creek.—Llano County; an intermittent tributary through San Fernando Creek to Llano River and thus to the Colorado, in the northwestern part of the county; length, 5 miles. Llano topographic map.

Nueces River.—Rises 5 miles southeast of Rock Springs, in central part of Edwards County, at approximate altitude of 2,400 feet above sea level; flows southerly 40 miles through Edwards County and 40 miles through Uvalde County, then southeasterly 32 miles through Zavalla County, 35 miles through Dimmitt County and 50 miles through La Salle County; in the southeastern corner of La Salle County the stream bends toward the northeast and continues in that direction 38 miles through McMullen County, then again trends to the southeast in Live Oak County, which course it continues to its mouth, flowing 40 miles through Live County, 8 miles along the boundary of Live Oak and San Patricio counties, then 32 miles along the boundary of Nueces and San Patricio counties and enters Corpus Christi Bay (thence to the Gulf of Mexico). The stream forks into the East and West Nueces above the west central part of Uvalde County; total length, 315 miles; area of drainage basin, 16,800 square miles. Principal tributary, Frio River. Most of the other tributaries are short and unimportant.

The Nueces is not large as streams are rated in a humid country, but traversing a semiarid region, it is of the greatest economic importance, the drainage area lying almost wholly upon the Gulf Coastal Plain. After leaving the mountains of Edwards Plateau at a point near Uvalde, the flow varies on account of seepage losses. The stream is formed by springs in the Edwards Plateau north of the Balcones escarpment and a constant flow is maintained until it reaches the foot of the Edwards Plateau, where the faulting zone intercepts the flow and it enters the porous formations below the surface. The underflow reaches the surface at points down stream where the gravel has been washed from the solid rock bottom and the flow is materially increased thereby.

The annual rainfall in the drainage varies from 15 inches in the plains country to 40 inches in the mountainous portion of the catchment.

Distributed along the river from source to mouth are a number of dams which furnish water for irrigation and municipal purposes. Artesian water exists in the Coastal Plain drainage and lands are being irrigated thereby. Gaging stations at Cinonia, Three Rivers, and Calallen. Rock Springs, Nueces, Brackett, and Uvalde topographic maps. See Second Report of Texas Board of Water Engineers for list of certified filings of appropriations for use of water.

Oak Branch.—Bell County; a small intermittent stream flowing easterly 3 miles into Cowhouse Creek (tributary through Leon River to Little and Brazos rivers) near Brookhaven. Gatesville topographic map.

Oak Creek.—Coke, Nolan and Runnels counties; rises 10 miles west of Dora in the southeastern part of Nolan County; flows southeasterly 16 miles through Nolan County, 4 miles through Coke County, thence 23 miles through Runnels County to its junction with Colorado River, 3 miles south of Maverick in the western part of Runnels County. Sweetwater and Hayrick topographic maps.

Oak Creek.—Donley and Hall counties; rises in southern part of Donley County; flows southerly about 9 miles, sinks in the Sand Hills in Hall County, about 10 miles southwest of Memphis; its drainage probably extends 5 or 6 miles on to Morgan Creek (tributary through Indian Creek to Prarie Dog Town Fork of Red River and thus through Red River to the Mississippi).

[illegible] CREEK.—[illegible] stream [illegible] miles long flowing northerly into [illegible] Creek (tributary to [illegible] River) in the northeastern part of the county.

[illegible] CREEK.—[illegible] County; small intermittent stream in northern part of county; flows southwesterly [illegible] miles into [illegible] Creek, thence through [illegible] to Rio Grande, 4 miles west of [illegible] topographic map.

[illegible] CREEK.—[illegible] County; a stream flowing southwestward 4½ miles into [illegible] Creek (tributary to [illegible] Creek, and thus to Brazos River), southwest of [illegible] post office.

[illegible] CREEK.—[illegible] County; rises 2 miles north of [illegible] in the southern part of the county; flows [illegible] miles to its junction with Llano River (tributary to the [illegible]) [illegible] mile east of Llano. Llano topographic map.

OATMEAL CREEK.—Burnet County; rises [illegible] miles southeast of Burnet in eastern part of county; flows [illegible] miles into South Fork of San Gabriel River (tributary to [illegible] River, thence to Little River and the Brazos), [illegible] miles [illegible] of [illegible]. Burnet topographic map.

[illegible] CREEK.—[illegible] rises in the southwestern part of Fayette County near [illegible]; flows westerly 1 mile through Fayette County, then [illegible] miles through [illegible] County to Peach Creek (tributary to Guadalupe River). [illegible] topographic map.

[illegible] CREEK.—Angelina County; small stream in southeastern part of county [illegible] into [illegible] Creek, thence to Angelina and Neches rivers.

[illegible] LAKE [illegible].—[illegible] County; in the northeastern part of county, 5½ miles northeast of [illegible] Hill; [illegible] Branch (tributary to Gulf of Mexico through [illegible] Creek, East Fork San Jacinto River, and San Jacinto [illegible]) [illegible] mile long and about one-half mile wide. [illegible] Hill topographic map.

[illegible] CREEK.—[illegible] County; small intermittent tributary to East Nueces River (tributary to Nueces River) [illegible] miles north of Vance in the eastern part of the county; flows [illegible] 7 miles. Nueces topographic map.

OJO DE AGUA.—Karnes County; southeast of Helena in the southern part of the county; flows into San Antonio River and thus to the Guadalupe.

OKLAHOMA DRAW.—[illegible] County; rises in eastern part; flows northeasterly 5 miles into Jesse Arroyo (tributary to Salt Fork of Red River, thence to Prairie Dog Town Fork of the Red, and thus through Red River to the Mississippi).

OLD RIVER.—Burleson County; small stream in southeastern part of county joining Brazos River 2½ miles east of Clay. Gay Hill topographic map.

OLD RIVER.—Chambers County; near Anahuac; a tidal stream connected with Trinity River; former channel of Trinity River.

OLD RIVER.—Knox County; rises east of Truscott in northern part of county; flows southeasterly about 12 miles into South Wichita River (tributary to Wichita River, and thus through Red River to the Mississippi) in northeastern part of county.

OLD RIVER.—Harris County; in southeastern part of county near Lynchburg; an arm of Buffalo Bayou; about 4 miles long, and one-half mile wide in places. Burnett Bay topographic map.

OLD RIVER.—Victoria County; 12 miles south of the town of Victoria in southern part of county; former channel of Guadalupe River.

OLEYS CREEK.—Stonewall County; a small intermittent stream in southern part of county; flows northerly into Double Mountain Fork of Brazos River (tributary to the Brazos) northwest of Pastura. Roby topographic map.

OLIVE BRANCH.—Burnet County; small stream flowing northerly 4 miles into South Rocky Creek (tributary to Rocky Creek, thence through Lampasas and Little rivers to the Brazos) in the northeastern part of the county. Burnet topographic map.

OLIVERS CREEK.—Wise and Denton counties; rises about 3 miles southeast of Decatur in Wise County; flows southeasterly 18 miles into Denton Creek (tributary to the Elm Fork of Trinity River, thence to the Trinity) about 2 miles northeast of Justin in Denton County.

OLIVE FORK OF SOUTH PEASE RIVER.—Motley County; rises about 8 miles south of Lyman in the southwestern corner of county; flows easterly 11 miles to its junction with Walnut Creek to form South Pease River (tributary through Middle Pease to Pease River and thus through Red River to the Mississippi) about 4 miles southeast of Roaring Springs.

OLMOS CREEK.—Bexar County; an intermittent branch of San Antonio River north of the City of San Antonio; rises in the north central part of the county; flows southerly 12 miles to its confluence with San Antonio River (tributary to Guadalupe River) near the northern city limits of San Antonio. San Antonio topographic map.

OLMOS CREEK.—Duval, Jim Wells, Brooks, Willacy, and Kleberg counties; rises in the western part of Duval County (upper part of stream in this county known locally as Poquita Creek); flows southeastward 43 miles through Duval County, 5 miles through the southwestern part of Jim Wells County, 10 miles through northeastern part of Brooks County, then northeastward 10 miles through the northwestern part of Willacy County, thence 5 miles through the southern part of Kleberg County into Baffins Bay, an arm of the Gulf of Mexico.

OLMOS CREEK.—Karnes County; small tributary through Escondido Creek to San Antonio River and thus to the Guadalupe; flows through southern part of county.

OLMOS CREEK.—Uvalde and Zavalla counties; small intermittent stream uniting with Gato Creek (tributary to the Nueces through Chapparosa, Turkey, and Elm creeks), in the northwestern part of Zavalla County; flows southerly; length, 10 miles. Brackett topographic map.

ONION BRANCH.—Parker County; an easterly flowing stream 4 miles long joining Kickapoo Creek (tributary to Brazos River) west of Buckner in southwestern part of county. Weatherford topographic map.

ONION CREEK.—Archer County; rises about 7 miles southeast of Archer City in southern part of the county; flows northerly 11½ miles into Little Wichita River (tributary to Red River and thus to the Mississippi) about 7½ miles northeast of Archer City.

Hays-Blanco county line in the southeastern part of Blanco County; flows

ONION CREEK.—Blanco, Hays, and Travis counties; rises about 1 mile west of southeasterly 37 miles through the northern part of Hays County, then 22 miles through the southern part of Travis County into Colorado River, about 1½ miles north of Garfield. Blanco and Austin topographic maps.

ONION CREEK.—Coryell County; a stream flowing southwesterly to a point near Eagle Springs in eastern part of county, where it joins Station Creek (tributary to Leon River and thus through Little River to the Brazos); length, 4 miles. Temple topographic map.

ONION CREEK.—Ellis County; rises south of Waxahachie in central part of Ellis County; flows southeasterly in Waxahachie Creek (tributary through Pecan Creek to Richland Creek, thence to Trinity River) in southeastern part of county; length, 18 miles.

Opossum Creek.—Ellis County; [illegible] South Fork of [illegible] Creek (tributary to [illegible] and Richland creeks and thus to the Trinity River), 2 miles northeast of Auburn in western part of the county. [illegible] topographic map.

Opossum Creek.—McCulloch County; an intermittent stream emptying into Brady Creek (tributary through San Saba River to the Colorado), southwest of Rochelle in the southeastern part of the county; length, 12 miles. Brady topographic map.

Opossum Creek.—Williamson County; rises 2 miles south of Corn Hill; flows southeasterly 15 miles into Williamson Creek (tributary through San Gabriel River to Little River and thus to the Brazos), 1½ miles south of Granger. Taylor and Georgetown topographic maps.

Opossum Hollow.—Cooke County; a small intermittent stream about 2 miles south of Marysville in northern part of county; flows into South Fish Creek, thence to Fish Creek and thus through Red River to the Mississippi. Gainesville topographic map.

Opossum Hollow.—Edwards County; a small intermittent tributary in the southern part of the county; unites with West Nueces River (thence to the Nueces) about 2 miles below Black Water Hole; flows southwesterly 4 miles. Nueces topographic map.

[illegible] Creek.—Chambers County; a small stream; rises in southern part of the county in Stephenson Lake; flows northwestward 4 miles into Trinity Bay [illegible].

[illegible] Creek.—Webb County; a small intermittent stream in eastern part of the county; flows northwestward 12 miles to its junction with Prieto Creek (tributary to the Nueces).

Oso Creek.—Nueces County; rises in the northern part of the county; flows southeastward 15 miles through an inlet into Corpus Christi Bay, thence to Gulf of Mexico.

Oso Creek.—Presidio County; rises on western slope of Chinatie Mountains 12 miles northwest of Shafter; flows southeasterly 8 miles into Cibolo Creek (tributary to Rio Grande) 5 miles northwest of Shafter. Shafter topographic map.

Otter Creek.—Henderson and Anderson counties; rises about 1 mile east of Athens in Henderson County; flows southwesterly 18 miles into Catfish Bayou (tributary to Trinity River) northeast of Cayuga in northwestern part of Anderson County.

Overcup Pond.—Cass County; about 4 miles northwest of Alamo Mills in northeastern part of county; formed by an old channel of Sulphur River (tributary to Red River and thus to the Mississippi). Texarkana topographic map.

Overcup Pond.—Cass County; an expansion of Powell Creek in northern part of County, about 3 miles northwest of Douglasville. (See Powell or Lick Creek.) Linden topographic map.

Overcup Slough.—Cass County; about 4 miles northwest of Douglasville in northern part of county; outlet of Overcup Pond. (See Powell or Lick Creek.) Linden and New Boston topographic maps.

Owens Branch.—Lee County; a small intermittent stream flowing northeasterly into Second Yegua Creek (tributary through Yegua Creek to Brazos River) in the northwestern part of county. Bastrop topographic map.

Owl Creek.—Fayette County; rises in northern part of county; tributary through Rabbs Creek to Colorado River; length, 9 miles.

OXBOW CREEK.—Hall County; a stream 5 miles long flowing northeasterly through western part of county to Little Red River (tributary to Prairie Dog Town Fork of Red River and thus through Red River to the Mississippi).

OX YOKE CREEK.—King County; rises in northeastern part of county; flows southerly 7 miles into South Wichita River (tributary to Wichita River and thus through Red River to the Mississippi) about one-half mile west of its intersection with the east boundary of county.

OYSTER BAYOU.—Chambers County; a tidal stream rising in the east central part of the county; flows southeasterly 12 miles into East Galveston Bay, and thus to Gulf of Mexico.

OYSTER BAYOU.—Fort Bend County; rises 5 miles north of Richmond; flows southeasterly 27 miles into Brazos River west of Duke; marshy throughout its course.

OYSTER CREEK.—Fort Bend and Brazoria counties; rises in the eastern part of Fort Bend County, near Sugarland; flows southerly and southeasterly 12 miles through Fort Bend County, then 40 miles through Brazoria County into the Gulf of Mexico 2 miles east of Velasco.

OYSTER CREEK.—Hunt County; rises about 2 miles southwest of Wolfe City in northern part of county; near northern boundary of county; flows southerly 4 miles into South Sulphur River (tributary to Sulphur River, thence through Red River to the Mississippi).

PA CREEK.—King County; small stream flowing northwesterly 4 miles through western part of county into South Wichita River (tributary to Wichita River and thus through Red River to the Mississippi).

PAESTA CREEK, OR EAST ARKANSAS RIVER.—Bee County; rises in northern part of county; flows southeasterly about 20 miles, passes through Beeville, and joins Aransas River (and thus to Copano Bay and Gulf of Mexico) near Skidmore in southern part of county.

PAGE CREEK.—Kinney County; a small intermittent tributary to West Nueces River (tributary to the Nueces) in northeastern part of county; flows southwesterly 3 miles. Brackett topographic map.

PAINT CREEK.—Brown, Eastland, and Callahan counties; rises 3 miles west of Sabanna; flows southeasterly 17 miles into Pecan Bayou (tributary to the Colorado) at Byrds Store. Coleman topographic map.

PAINT CREEK.—Bastrop County; a small intermittent stream flowing northwesterly into Third Yegua Creek (which discharges through Yegua Creek into Brazos River) southeast of McDade. Bastrop topographic map.

PAINT CREEK.—Young County; rises near Orth in northwestern part of county; flows southerly 6 miles into Brazos River.

PAINT CREEK.—Haskell and Stonewall counties; rises in northeastern corner of Stonewall County; flows eastward 31 miles into California Creek (tributary through Clear Fork of Brazos River to the Brazos) in the southeastern part of Haskell County.

PAISANO CREEK.—Brewster, Presidio, and Pecos counties; an intermittent stream rising near Paisano near line of Presidio and Brewster counties, at an approximate altitude of 5,200 feet above sea level; flows northeasterly 80 miles into Pecos River (tributary to Rio Grande) 8 miles west of Grandfalls. Alpine topographic map.

PAJARITOS CREEK.—Wilson County; near the town of Floresville in the central part of the county; small stream flowing into San Antonio River and thus to the Guadalupe.

[illegible] Hutchinson County; rises north-[illegible] Hutchinson County; flows north-[illegible] near northwestern corner of [illegible] Beaver River (tributary to North Fork of [illegible] River [illegible] the Canadian and Arkansas to Mississippi [illegible].

[illegible] an intermittent stream rising [illegible] 24 miles into Canadian River [illegible] Arkansas River) 25 miles [illegible] county.

[illegible] small spring discharging into Bayou [illegible] River) in southern part of [illegible].

[illegible] flows southward 8 miles into Cass [illegible] of Sulphur.

[illegible] miles long flowing south-[illegible] tributary to Rio Grande) [illegible].

[illegible] Trinity River in northern [illegible].

[illegible] 2½ miles southeast [illegible] 5 miles into Rio [illegible] map.

[illegible] rises about 5 miles [illegible] flows southeasterly [illegible] in eastern part of Sabine [illegible].

[illegible] in the northern part of the county; [illegible] tributary to Frio River and [illegible].

[illegible] 3 miles north of Fredericksburg [illegible] 14 miles into Peder-[illegible] southeast of Fredericks-[illegible].

[illegible] stream in north-[illegible] with Elm [illegible] topographic map.

[illegible] Brooks, and Willacy counties; [illegible] flows eastward 2 miles [illegible] part of Duval County, [illegible] Hogg County, 30 [illegible] Brooks County, then 24 miles through Willacy County into [illegible] and Gulf of Mexico; 28 miles [illegible] San Antonio Creek it forms a lake [illegible] Laguna de Loma Blanca.

Palo Duro Creek.—Curry County, N. Mex., and Deaf Smith and Randall counties, Tex.; rises in [illegible] part of Curry County, N. Mex.; flows easterly 75 miles to a point about 4 miles northeast of Canyon in Randall County, where it enters Prairie Dog Town Fork of Red River (tributary to Red River and thus to the Mississippi); dry channel, carrying flood waters only at rare intervals; course and origin not definite.

Palo Pinto Creek.—Palo Pinto County; formed near Mingus Lake in southwestern part of county by union of North and South Palo Pinto creeks; flows northeasterly 28 miles into Brazos River, 1½ miles southeast of Brazos in southeastern part of county. Palo Pinto topographic map.

PALO RUCIO CREEK.—Jim Wells and Kleberg counties; rises in eastern part of Jim Wells County; flows southeasterly 15 miles to its junction with San Fernando Creek (and thus to Baffins Bay and Gulf of Mexico) in the northwestern part of Kleberg County.

PALUXY CREEK.—Erath, Hood, and Somervell counties; formed 1 mile west of Bluff Dale in northern part of Erath County by union of North and South Paluxy creeks; flows easterly 27 miles into Brazos River 3 miles northeast of Glenrose in eastern part of Somervell County. Stephenville and Granbury topographic maps.

PANTHER CANYON.—Presidio County; rises about 1 mile north of Panther Spring 4 miles southwest of Ojo Mexicano; flows southerly 6 miles into Rio Grande 12 miles west of Lajitas. Terlingua topographic map.

PANTHER CREEK.—Bowie County; rises 1 mile northwest of Corley; flows southwesterly 4½ miles into Anderson Creek (tributary to Sulphur River and thus through Red River to the Mississippi) about 2 miles southeast of Carbondale. New Boston topographic map.

PANTHER CREEK.—Briscoe and Hall counties; rises in eastern part of Briscoe County; flows southeasterly 5 miles into Little Red River (tributary to Prairie Dog Town Fork of Red River and thus through Red River to the Mississippi) in western part of Hall County.

PANTHER CREEK.—Collingsworth County; a stream rising in eastern part of county and flowing 3 miles into Salt Fork of Red River (tributary to Prairie Dog Town Fork of the Red and thus through the Red to the Mississippi).

PANTHER CREEK.—Denton County; small stream flowing into Little Elm Creek (tributary to Elm Fork of the Trinity, thence to Trinity River) in the eastern part of county.

PANTHER CREEK.—Franklin County; rises about 4 miles southwest of Mount Vernon in central part of county; flows southeasterly 6½ miles into Big Cypress Creek (tributary to Caddo Lake and thus through Red River to the Mississippi) in the southeastern part of the county.

PANTHER CREEK.—Karnes County; rises in southern part of county; flows into Escondido Creek and thus to San Antonio River (tributary to Guadalupe River). Very small.

PANTHER CREEK.—Leon County; small stream flowing into Alligator Creek (tributary through Buffalo and Upper Keechi creeks to Trinity River) 2 miles north of Jewett.

PANTHER CREEK.—Mason County; a stream 6 miles long flowing through the central part of the county into Llano River and thus to the Colorado. Mason topographic map.

PANTHER CREEK.—Montgomery County; small stream in southern part of the county; flows southeasterly to its junction with West San Jacinto River, thence to San Jacinto River, Galveston Bay, and Gulf of Mexico.

PANTHER CREEK.—Montague County; rises about 2½ miles southeast of Nocona in northern part of county; flows northerly 14 miles into Red River (tributary to the Mississippi) about 3 miles west of Valley School. Montague topographic map.

PANTHER CREEK.—Palo Pinto County; flows southeasterly 6 miles into Palo Pinto Creek (tributary to Brazos River) 2 miles northwest of Gordon in southwestern part of county. Palo Pinto topographic map.

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PANTHER CREEK.—San Saba and Llano counties; a small intermittent stream in the northwestern part of Llano County; flows into Field Creek (and thus through San Fernando Creek to Llano and Colorado rivers) north of the town of Field Creek in the southern part of San Saba County; length, 4 miles. Llano topographic map.

PAPALOTE CREEK.—Bee and San Patricio counties; rises west of Tyrant in the southern part of Bee County; flows southeastward 3 miles in Bee County, southeastward again 3 miles and northeastward 2 miles in San Patricio County, then northeastward 7 miles in Bee County to its junction with Aransas River (thence to Gulf of Mexico through Copano Bay) near the corner common to Bee, Refugio, and San Patricio counties.

PARIDA CREEK.—Webb County; small tributary to Salado Creek (thence to the Nueces) in the northeastern part of the county.

PARILLA CREEK.—Duval County; rises in the western part of the county; flows southeasterly 17 miles to its junction with Poquita Creek (thence to Gulf of Mexico through Baffins Bay) 6 miles northeast of Realitos in the south central part of the county.

PARITA CREEK.—Bexar County; rises northeast of Elmendorf; flows through the southeastern part of the county into Calaveras Creek and thus to San Antonio River (tributary to the Guadalupe). San Antonio topographic map.

PARITA CREEK.—Karnes County; a small stream flowing through the southern part of the county; joins Escondido Creek (tributary to San Antonio River and thus to the Guadalupe).

PARKER CREEK.—Anderson County; a stream flowing southwesterly 9 miles into Trinity River in southwestern part of the county.

PARKER CREEK.—Donley and Hall counties; rises in southeastern part of Donley County; flows southeasterly 11 miles into Berkley Creek (tributary to Prairie Dog Town Fork of Red River and thus through Red River to the Mississippi) about 4 miles south of Memphis in northeastern part of Hall County.

PARKS CREEK.—Gray and Donley counties; rises in southeastern part of Gray County; flows southerly 9 miles into Whitefish Creek (tributary to Salt Fork of Red River and thus through Prairie Dog Town Fork of the Red and Red rivers to Mississippi River) in northeastern part of Donley County.

PARKER CREEK.—Marion County; small stream about 9 miles west of Jefferson; flows into Big Cypress Bayou (tributary to Caddo Lake and thus through Red River to the Mississippi).

PARKERS CREEK.—Medina County; rises in the northwestern part of the county; flows southerly 16 miles into Seco Creek (tributary to Nueces River through Hondo Creek and Frio River).

PARKER CREEK.—Oldham County; rises 9 miles south of Cheyenne; flows northerly 8 miles to its junction with Canadian River (tributary through Arkansas River to the Mississippi) a mile southwest of Tascosa in northeastern part of county.

PARTRIDGE CREEK.—Hamilton County; an intermittent stream in western part of county, flowing northeasterly 10 miles to a point 8 miles south of the town of Hamilton, where it enters Cowhouse Creek, which discharges into Brazos River through Leon and Little rivers. Hamilton topographic map.

PASTOREX CREEK.—Austin County; a stream flowing easterly 7 miles into West Fork of Mill Creek (tributary to Mill Creek and thus to Brazos River) west of Bellville.

PATRICK CREEK.—Parker County; rises 1 mile west of Lambert in western part of county; flows southerly into Brazos River 1½ miles south of Hiner. Weatherford topographic map.

PATRICK BAYOU.—Harris County; rises 3½ miles southwest of San Jacinto Battlefield in southeastern part of county; flows northerly 2½ miles into Buffalo Bayou and thus to Gulf of Mexico; partially intermittent. Laporte topographic map.

PATROON BAYOU.—Shelby and Sabine counties; rises about 3 miles south of Neuville in Shelby County; flows southeasterly 27 miles into Sabine River in eastern part of Sabine County, 5 miles southeast of Isla.

P. D. CREEK.—Bastrop County; small intermittent stream; joins Colorado River 2 miles north of Smithville in the southeastern part of the county; length, 6 miles. Bastrop topographic map.

PAWPAW BRANCH.—Grayson County; small intermittent tributary to Red River north of Red Branch. Denison topographic map.

PEACH CREEK.—Bastrop, Fayette, and Gonzales counties; rises 4 miles northeast of Delhi in the southern part of Bastrop County; flows southerly 7 miles through Bastrop County, 8 miles through Fayette, then 27 miles through Gonzales County into Guadalupe River about 10 miles southeast of Gonzales. Flatonia topographic map.

PEACH CREEK.—Brazos County; rises near Welburn in southern part of County; flows eastely 12 miles into Navasota River (tributary to the Brazos).

PEACH CREEK.—Caldwell County; an intermittent stream east of Luling in southern part of county; flowing into Plum Creek (tributary to San Marcos River and thus to Guadalupe River). San Marcos topographic map.

PEACH CREEK, SANDY FORK.—Caldwell and Gonzales counties; rises near Delhi in the eastern part of Caldwell County; flows southerly and southeasterly 14 miles through Caldwell County, then 18 miles through Gonzales County into Peach Creek (tributary to Guadalupe River) 4 miles southeast of Possumtrot. Flatonia topographic map.

PEACH CREEK.—Grimes County; small stream flowing westerly 4 miles into Ben Fort Creek (tributary to Navasota River and thus to the Brazos) in north central part of county.

PEACH CREEK.—Robertson County; rises in southwest corner of county; flows southwestward 6 miles into Campbells Creek (tributary through Little Brazos River to the Brazos) 2 miles west of Benchley.

PEACH CREEK.—San Jacinto County; small stream in southwestern corner of the county; flows northeasterly 5 miles into Winter Creek (tributary to East San Jacinto River, San Jacinto River, and Gulf of Mexico).

PEACH CREEK.—Wharton County; rises in the north central part of the county; flows southeasterly 17 miles into San Bernard River and thus to Gulf of Mexico.

PEACH CREEK.—Walker, San Jacinto, Montgomery, and Harris counties; rises in the southeastern part of Walker County; flows southerly and southeasterly 2 miles, forming the boundary between Walker and San Jacinto counties; 17 miles along the boundary of San Jacinto and Montgomery counties, 18 miles through Montgomery County, then 1 mile through Harris County into East San Jacinto River (tributary to Galveston Bay and Gulf of Mexico).

PEASE RIVER.—Swisher, Briscoe, Floyd, Motley, Cottle, Hardeman, Foard, and Wilbarger counties; rises about 2 miles north of Whitfield, in southeastern part of Swisher County; flows eastward 156 miles into Red River (tributary to the Mississippi) 5 miles north of Oaklaunion, in northern part of Wilbarger County; called North Pease River above its confluence with Middle Pease River, in northeastern part of Cottle County.

PECAN BAYOU.—Callahan, Coleman, Brown, and Mills counties; rises 6 miles west of Baird in Callahan County at an approximate altitude of 2,000 feet above sea level; flows southeasterly 25 miles through Callahan County, 22 miles through Coleman County, [illegible] miles through Brown County, then 16 miles through Mills County into Colorado River 3 miles northwest of Big Valley in southern part of Mills County.

[illegible] the [illegible] on the stream and water is stored for municipal uses by the city of Brownwood.

See Second Report of Texas Board of Water Engineers for list of certified filings for appropriation of water. Coleman, Brownwood, and San Saba topographic maps.

PECAN BAYOU.—Red River County; rises about 5 miles north of Detroit, in northwestern part of county; flows eastward 40 miles across the county into Red River (tributary to Mississippi River) near northeastern corner of county.

PECAN BAYOU, NORTH FORK OF.—Red River County; rises about 9 miles northeast of Detroit in northern part of county; flows southeasterly 4 miles into Pecan Bayou (tributary to Red River and thus to the Mississippi).

PECAN BAYOU, SOUTH FORK OF.—Red River County; rises about 2½ miles northeast of Bogata in central part of county; flows easterly 9 miles into Pecan Bayou (tributary to Red River and thus to the Mississippi).

PECAN BRANCH.—Cooke County; small intermittent stream flowing through southwestern part of county into Clear Creek, thence to Elm Fork of Trinity River and the Trinity. Gainesville topographic map.

PECAN BRANCH.—McLennan County; rises 2 miles northeast of Oglesby; flows northeasterly 8 miles into Middle Bosque River (tributary through South Bosque to Bosque River and thus to the Brazos). Temple and Waco topographic maps.

PECAN SPRING BRANCH.—Lampasas and Burnet counties; rises north of Bunker Hill in northern part of Burnet County; flows northeasterly into Donalson Creek (tributary through Sulphur Creek to Lampasas River, then through Little River to the Brazos) 2 miles southwest of Lampasas; length, 8 miles. Lampasas and Burnet topographic maps.

PECAN SPRINGS BRANCH.—Mason County; a small intermittent stream in the southeastern part of the county; empties into Marshall Creek and thus through Cold Springs Creek to Hickory Creek (tributary through the Llano to Colorado River); length, 3 miles. Mason and Llano topographic maps.

PECAN CREEK.—Bell County; a stream flowing southeasterly 5 miles to Oenaville, where it enters Big Elm Creek (tributary to Little River and thus to the Brazos) in eastern part of the county. Temple topographic map.

PECAN CREEK.—Cooke County; rises about a mile northwest of Windsor Siding; flows southeasterly 9 miles into Elm Fork of Trinity River (tributary to the Trinity) about 3 miles south of Gainesville. Gainesville topographic map.

PECAN CREEK.—Denton County; rises in the northeastern part of county; flows southerly 15 miles into Little Elm Creek (tributary to Elm Fork of Trinity River, thence to the Trinity), in the eastern part of the county.

PECAN CREEK.—Eastland and Stephens counties; rises in northwestern part of Eastland County; flows northeasterly 13 miles into Battle Creek (tributary to Bear Creek and thus through Sandy, Hubbard, and Gonzales creeks to Clear Fork of Brazos and Brazos rivers) 2 miles south of Mankins Mill, in southwestern part of Stephens County. Albany topographic map.

PECAN OR CHAMBERS CREEK.—Ellis and Navarro counties; formed southwest of the town of Waxahachie, in southwestern part of Ellis County, by union of North and South Forks of Pecan Creek; flows southeasterly 55 miles into Richland Creek (tributary to Trinity River) north of Winkler, in southwestern part of Navarro County.

PECAN CREEK.—Fannin, Hunt, and Delta counties; rises in southeastern part of Fannin County near southern boundary; flows southeasterly 11 miles into Middle Fork of Sulphur River (tributary through South Sulphur River to Sulphur River, and thus through Red River to the Mississippi) in southwestern part of Delta County near the western county line.

PECAN CREEK.—Hamilton County; rises 3 miles south of the town of Hamilton, in central part of county; flows northeasterly to a point 7 miles northeast of Hamilton, where it enters Leon River (tributary to Little River and thus to the Brazos). Hamilton topographic map.

PECAN CREEK.—Hill County; rises 6 miles southeast of Itasca, in northern part of the county; flows southeasterly into Richland Creek (tributary to Trinity River), in eastern part of county. Cleburne topographic map.

PECAN CREEK.—Gillespie County; rises 13 miles northwest of Fredericksburg; flows southeasterly 9½ miles into Live Oak Creek (tributary to Pedernales River); partially intermittent. Kerrville and Fredericksburg topographic maps.

PECAN OR CHAMBERS CREEK, NORTH FORK.—Johnson and Ellis counties; rises in the town of Egan, central part of Johnson County; flows southeasterly 22 miles to its confluence with the South Fork of Pecan Creek, forming Pecan Creek (tributary to Richland Creek, thence to the Trinity) in the southwestern part of Ellis County. Cleburne topographic map.

PECAN OR CHAMBERS CREEK, MIDDLE FORK.—Johnson County; small stream flowing to a point east of Stubblefield, in the eastern part of county, where it joins the South Fork of Pecan Creek, thence to Pecan and Richland creeks and Trinity River. Cleburne topographic map.

PECAN CREEK.—Llano County; a stream 6 miles in length flowing into Colorado River in the southeastern part of the county. Burnet topographic map.

PECAN CREEK.—Montague County; rises at Nocona, in northern part of county; flows northerly 10 miles into Red River (which discharges into the Mississippi) about 2½ miles northeast of Red River Station Crossing. Montague topographic map.

PECAN CREEK.—San Saba and Llano counties; rises 4 miles southwest of Cherokee, in the southern part of San Saba County; flows southward 15 miles into Llano River (tributary to the Colorado) a mile west of Llano, in the central part of Llano County. Llano topographic map.

PECAN CREEK.—Sutton and Kimble counties; a small stream in the northwestern part of Kimble and western part of Sutton counties; flows through West Copperas and Copperas Creeks to North Llano River and thus to the Llano (tributary to Colorado River); length, 3 miles. Fort McKavett topographic map.

PECAN CREEK.—Tom Green County; rises in the southern part of the county; flows northwestward 21 miles into South Concho River (tributary to the Concho and thus to Colorado River) 9 miles south of San Angelo, in the central part of the county. San Angelo topographic map.

PECAN SPRING.—Coke County; small intermittent spring in upper portion of Red Bank Creek drainage, near Coke-Tom Green county line. Hayrick topographic map.

PECOS RIVER.—Rises on eastern slope of Santa Fe Mountain Range, in Mora County, N. Mex.; enters the State of Texas near State Line, Loving County; meanders in a general southeasterly course approximately 170 miles through a narrow alluvial valley to Sheffield; from this point it continues in a southeasterly course 90 miles through a deep box canyon to its junction with Rio Grande 10 miles west of Comstock, Val Verde County; principal tributaries (intermittent) Toyah and Comanche creeks which enter in the State of Texas, and Delaware Creek just north of New Mexico-Texas State line. Gaging stations at Angeles, 1914–1918; Barstow, 1914–1918; Grandfalls, 1915–1918; near Moorhead, 1900–1918; near Pecos, 1898–1907; near Marigueretta flume (1898), 1900–1907; West Valley ditch near Pecos, 1900–1906.

This stream is the principal tributary of the lower Rio Grande.

There are no water-power developments along the stream in Texas, but considerable water is diverted near Pecos and Grandfalls for irrigation. See Second Report of Texas Board of Water Engineers for list of certified filings for appropriation of water.

PEDERNALES RIVER.—Kimble, Gillespie, Blanco, Hays, and Travis counties; rises 5 miles west of Harper in the southeastern corner of Kimble County; flows southerly and easterly 4 miles through Kimble County, 48 miles through Gillespie County, 38 miles through Blanco County, 2 miles through Hays County, thence 14 miles through Travis County into Colorado River 3 miles east of the western Travis county line; drainage area, 1,300 square miles; one of the principal tributaries to Colorado River. Kerrville, Fredericksburg, and Blanco topographic maps.

PEDRIZA CREEK.—Oldham and Hartley counties; an intermittent stream rising in southern part of Hartley County, and flowing southeasterly into Canadian River (which discharges into the Mississippi through Arkansas River) 8 miles west of Cheyenne in northern part of Oldham County.

PEN BRANCH.—King County; a stream flowing easterly 13 miles into Croton Creek (tributary to Brazos River) in southern part of county.

PENA CREEK.—Dimmit and Zavalla counties; rises in northwestern part of Dimmit County; flows northely 20 miles to its junction with Elm Creek (tributary to Nueces River) in southwestern part of Zavalla County.

PENDENCIA CREEK.—Dimmit and Zavalla counties; intermittent stream; flows northward 14 miles to its junction with Comanche Creek (thence to Nueces River through Elm Creek) in southwestern part of Zavalla County.

PENN CREEK.—Nacogdoches County; small stream flowing into Beech Creek (tributary through East Shawnee Creek to Angelina River and thus to the Neches) in northern part of county.

PEPPER CREEK.—Bell County; rises near the village of Howard in northern part of county; flows southwesterly 8 miles into Leon River (tributary to Little River and thus to the Brazos) 2½ miles east of Belton. Temple topographic map.

PEPPERCAMP CREEK.—Fannin County; small tributary to Red River (which discharges into the Mississippi) in northwestern part of county.

PERDIDO CREEK.—Goliad County; rises in the northeastern part of the county; flows easterly 15 miles into Coleto Creek and thus to Guadalupe River.

PERDIZ CREEK.—Presidio County; an intermittent stream flowing southeasterly 16 miles through central part of the county to its confluence with Alamita Creek (tributary to Rio Grande) 6 miles north of Alamito. Marfa topographic map.

PERSIMMON CREEK.—Terrell County; rises in southwestern part, 2 miles southeast of McClain Ranch; flows southeasterly 7½ miles into Indian Creek, tributary to Rio Grande; intermittent. Dryden Crossing topographic map.

PETE CREEK.—Stephens County; small stream flowing northerly 3 miles into Clear Fork of Brazos River (tributary to Brazos River) 2 miles southwest of Eliasville in northern part of county. Breckenridge topographic map.

PETER CREEK.—Burnet County; a stream 6 miles long flowing through the northern part of Hoover Valley in the southwestern part of the county into Colorado River. Burnet topographic map.

PETES CREEK.—Crosby County; rises near Crosby-Dickens county line, directly east of Emma; flows southerly 7 miles into White River (tributary to Salt Fork of the Brazos and thus to Brazos River).

PETRIFIED CANYON.—Donley County; northeastern part; a stream 8 miles long flowing into Whitefish Creek (tributary through Salt Fork of Red River to Prairie Dog Town Fork of the Red and thus to the Mississippi).

PETTYS CREEK.—Fayette County; joins Colorado River in the southeastern part of the county; length, 4 miles.

PEVELER CREEK.—Stephens and Young counties; rises near Ivan; flows northerly 6 miles into Clear Fork of Brazos River (tributary to Brazos River) 3 miles northeast of Eliasville in southern part of Young County. Breckenridge topographic map.

PEW BRANCH.—Coryell County; a stream flowing southeasterly 9 miles into Leon River (tributary to Little River and thus to the Brazos) 4 miles east of Leon Junction in eastern part of county. Gatesville topographic map.

PEWTER FIST CREEK.—Grayson County; flows southeasterly 6 miles into East Fork of Trinity River (tributary to Trinity River) in southern part of county.

PHANTOM LAKE.—Jeff Davis County; 4 miles southwest of Toyahvale near line of Jeff Davis and Reeves counties; outlet, Toyah Creek which discharges into Pecos River (tributary to Rio Grande); small. Fort Davis topographic map.

PHILLIPS MARSH.—Bowie County; about 6 miles north of Oakgrove in northwestern part of county; an expansion of East Prong of Mill Creek (tributary to Mill Creek and thus through Red River to the Mississippi) at its mouth.

PICKET SPRING BRANCH.—Camp County; rises about 4 miles northwest of Pittsburg; flows northerly 5 miles into Big Cypress Creek (tributary to Caddo Lake and thus through Red River to the Mississippi).

PICOSO CREEK.—Maverick and Zavalla counties; rises in eastern part of Maverick County; flows eastward 22 miles to its junction with Elm Creek; (tributary to Nueces River) near Cometa in the southwestern part of Zavalla County.

PIEDRA PINTA CREEK.—Kinney County; rises 6 miles northwest of Pinto Mountain; flows southwesterly 32 miles into Rio Grande at Dixie.

PILANCILLOS CREEK.—Dimmit County; intermittent tributary to San Roque Creek (thence to the Nueces) in southeastern part of the county; flows northward 10 miles.

PILGRIM CREEK.—Armstrong and Briscoe counties; rises in southern part of Armstrong County; flows southwesterly 4 miles into Prairie Dog Town Fork of Red River (tributary to Red River, and thus to the Mississippi) in northern part of Briscoe County.

P[illegible] [illegible] miles long flowing easterly into [illegible] near Hill-Johnson County line [illegible] topographic map.

P[illegible] rises at Pilot Grove in [illegible] miles into Sister Grove Creek [illegible] and thus to the Trinity) about [illegible] County.

P[illegible] part of the county; tribu[illegible] River; length 5 miles.

P[illegible] part of county 1½ miles [illegible] miles into Cypress Creek [illegible] River, Galveston Bay, [illegible] topographic maps.

P[illegible] and Red River counties; rises about 4 [illegible] part of Lamar County; flows [illegible] (tributary to the Mississippi) near [illegible] County.

P[illegible] flows north-easterly 23 miles into Red River (tributary to the Mississippi) near the northeastern corner of the county.

P[illegible] southeasterly into Trinity River in eastern part of county.

Pine Creek.—Red River County; [illegible] of Detroit near the Lamar-Red River county line; [illegible] Bayou (tributary to Red River [illegible] Mississippi) [illegible] miles northeast of Detroit.

Pine Creek.—[illegible] County; small stream in northern part of county flowing northeasterly [illegible] Creek (tributary to Whiteoak Bayou, [illegible] Red River to the Mississippi).

Pine Creek.—Wood County; rises about one-half mile east of Quitman; flows southwesterly [illegible] Sabine River (tributary to the Sabine).

Pine Lake.—Bowie County; a small lake formed by an old channel of Red River (which discharges into the Mississippi) about 7 miles west of Index in [illegible] part of county.

Pine Lake.—Cass County; about 6 miles west of Alamo Mills in northeastern part of county; formed by an old channel of Sulphur River which discharges into Mississippi River through Red River. Texarkana and Atlanta topographic maps.

Pine Gulley.—Harris County; small intermittent stream rising 1½ miles west of Park Place and flowing easterly 2½ miles into Simms Bayou (tributary to Buffalo Bayou and Gulf of Mexico). Park Place topographic map.

Pine Fork (Upper San Bernard River).—Austin County; rises in western part; flows southeasterly 4 miles into San Bernard River, thence to Gulf of Mexico.

Piney Creek.—Austin County; rises 5 miles north of Bellville; flows southeasterly 14 miles into Brazos River.

Piney Creek.—Bastrop County; rises 2 miles south of McDade in the northern part of the county; flows southwesterly 14 miles through the north central part of the county into Colorado River at Bastrop. Bastrop topographic map.

Piney Creek.—Houston, Trinity, Polk, and Tyler counties; rises in eastern part of Houston County; flows southeasterly 57 miles into Neches River near the corner of Polk and Tyler counties.

PINEY CREEK.—Bastrop County; in the central part of the county; small stream flowing into Sandy Creek, and thus through Walrut Creek to Colorado River; length, 4 miles. Bastrop and Flatonia topographic maps.

PINEY LAKE.—(McFarland Lake); Bowie County; about 4 miles southeast of Maud in southern part of county; formerly a channel of Sulphur River (tributary through Red River to the Mississippi). New Boston topographic map.

PINE OAK CREEK.—Navarro County; joins Richland Creek (tributary to Trinity River) southwest of the town of Richland in southwestern part of county.

PINOAK CREEK.—Caldwell County; small intermittent stream; joins West Fork of Plum Creek (tributary to Plum Creek, and thus through San Marcos River to the Guadalupe) 1 mile east of Joliet. San Marcos topographic map.

PINOAK CREEK.—Colorado and Wharton counties; rises in the southern part of Colorado County; flows southeasterly through Colorado County, then southerly through Wharton County to its junction with Sandy Creek (tributary to Navidad River, then to Lavaca River, and thus to Matagorda Bay and Gulf of Mexico) in western part of Wharton County about 5 miles west of Hahn.

PINOAK CREEK.—Robertson County; rises about 3 miles south of Franklin; flows southwesterly 13 miles into Little Brazos River (tributary to Brazos River) 3½ miles south of Hearne.

PINOAK CREEK.—Fayette County; rises 4 miles northeast of Flatonia; flows northeasterly 10 miles into Buckner Creek (tributary to Colorado River) 3 miles northeast of Muldoon. Flatonia topographic map.

PINOAK CREEK.—Fayette County; small intermittent stream; rises northeast of Waelder; flows through southwestern part of county to its junction with Peach Creek (tributary to Guadalupe River). Flatonia topographic map.

PINOAK CREEK.—Fayette County; small intermittent stream; rises northeast of Waelder; flows through southwestern part of county to its junction with Peach Creek (tributary to Guadalupe River). Flatonia topographic map.

PINOAK CREEK.—Gonzales County; east of Possumtrot in northern part of county; empties into Peach Creek thence to Guadalupe River; intermittent. Flatonia topographic map.

PINOAK CREEK.—Bastrop and Fayette counties; rises near the town of Paige in Bastrop County; flows southerly 15 miles through the eastern part of Bastrop County, then 3 miles through the northwestern part of Fayette County into Colorado River 2 miles north of West Point. Bastrop and Flatonia topographic maps.

PINOAK CREEK.—Fayette County; an intermittent stream 5 miles in length flowing into Buckner Creek and thus to Colorado River in western part of county. Flatonia topographic map.

PINE ISLAND BAYOU.—Liberty, Hardin, and Jefferson counties; rises in eastern part of Liberty County; flows southeasterly 25 miles into Neches River about 6 miles north of Beaumont; tidal stream 5 miles above mouth.

PINIAS CREEK.—Jim Wells and Nueces counties; rises in northern part of Jim Wells County; flows southeastward 15 miles through Jim Wells County, then 13 miles through the western part of Nueces County into Santa Petronilla Creek (thence to Gulf of Mexico through Baffins Bay).

PINTO CANYON.—Presidio County; small intermittent tributary rising 12 miles northeast of Ruidosa in western part of county; flows southwesterly to its junction with Rio Grande 5 miles southeast of Ruidosa. Ruidosa topographic map.

Polk Hollow.—Crosby County; rises near Crosby-Dickens county line; flows southwesterly 3 miles into White River (tributary to Salt Fork of Brazos River and thus to the Brazos) in southwestern part of county.

Polk Creek.—Coleman County; rises in the central part of county; flows 9 miles into Home Creek (tributary to Colorado River). Ballinger and Coleman topographic maps.

Pollards Creek.—Palo Pinto County; rises 3 miles north of the town of Mineral Wells; flows southwestward 9 miles through Mineral Wells into the Brazos opposite Barker Mountain in eastern part of county. Palo Pinto topographic map.

Pompey Creek.—Mills County; a stream 17 miles long uniting with Blanket Creek (tributary to Colorado River through Pecan Bayou) 4½ miles southwest of Mullen in the northwestern part of the county. Brownwood topographic map.

Pond Creek.—Milam and Falls Counties; rises near Falls-Bell county line; flows southeasterly 35 miles into Brazos River, southeast of Baileyville, in the northeastern portion of Milam County. Temple topographic map.

Pond Creek.—Wichita County; rises 6½ miles southeast of Iowa Park; flows southeasterly 1 mile into Wichita River (tributary to the Red and thus to Mississippi); intermittent. West Wichita Falls topographic map.

Pond Creek, East Fork.—Wichita County; rises 6 miles northeast of Iowa Park; flows southerly 7 miles into Pond Creek (tributary to Wichita River and thus to Red and Mississippi rivers); intermittent. Burkburnett and West Wichita Falls topographic maps.

Pond Creek, West Fork.—Wichita County; rises 4 miles north of Iowa Park; flows southeasterly 9½ miles into Pond Creek and thus to Wichita, Red, and Mississippi rivers; intermittent. Clara, Iowa Park, and West Wichita Falls topographic maps.

Pond Creek, Middle Fork.—Wichita County; rises about 5 miles northeast of Iowa Park; flows southerly about 6 miles into West Fork of Pond Creek (tributary to Wichita River and thus through Red River to the Mississippi); intermittent. West Wichita Falls topographic map.

Ponton Creek.—Lavaca County; rises near Lavaca-Gonzales county line 4 miles west of Henkhaus; flows southeasterly 12 miles into Rocky Creek (tributary to Lavaca River, Matagorda Bay, and Gulf of Mexico) 6 miles east of Shiner. Flatonia topographic map.

Pony Creek.—Erath and Hood counties; rises 4 miles northwest of Skippers Gap in eastern part of county; flows northeasterly 12 miles into Paluxy Creek (tributary to Brazos River) southeast of Paluxy near Hood-Somervell county line. Stephenville and Granbury topographic maps.

Pony Creek.—Runnels County; rises southeast of Ballinger in the southeastern part of the county; flows 11 miles into Colorado River. Ballinger topographic map.

Pool Branch.—Burnet County; small stream flowing southeasterly 3½ miles to its junction with North Fork of San Gabriel River (tributary to San Gabriel River, and thus through Little River to the Brazos) at Joppa. Burnet topographic map.

Pools Creek.—San Jacinto County; small stream flowing into Trinity River northeast of Staley in the northern part of county.

Pools Creek.—Madison County; rises about 3 miles north of Madisonville in the central part of county; flows southeasterly 13 miles into Bidais Creek (tributary to Trinity River).

Poor Hollow.—Schleicher County; an intermittent stream northwest of Fort McKavett in the eastern part of the county; flows through North Valley into San Saba River (tributary to the Colorado); length, 14 miles. Fort McKavett topographic map.

Poplar Creek.—Angelina County; rises about 2 miles north of Zavalla; flows easterly 12 miles into Angelina River (tributary to Neches River) in the eastern part of the county.

Porcion Creek.—Dimmit County; rises in southern part of county; flows northeasterly about 12 miles between Catarina and Asherton into Nueces River and thus to Gulf of Mexico; intermittent.

Porter Creek.—Wharton County; small stream in western part of county; flows southerly to its junction with West Mustang Creek, and thus to Mustang Creek, Navidad and Lavaca rivers and Gulf of Mexico.

Postoak Branch.—Burnet County; small stream flowing through Smithwick in the southern part of the county; unites with Colorado River at Postoak Crossing, 2 miles south of Smithwick; length, 4 miles. Burnet topographic map.

Postoak Branch.—Stephens County; rises 2 miles west of Caddo; flows northwesterly 3½ miles into Little Cedar Creek (tributary to Big Cedar Creek, and thus to Brazos River), in easterly part of county. Breckenridge topographic map.

Post Oak Branch.—Stephens County; an intermittent stream flowing northeasterly 7 miles into Gonzales Creek (tributary to Clear Fork of Brazos River and thus to the Brazos), 1 mile south of Breckenridge. Breckenridge topographic map.

Postoak Creek.—Archer and Clay counties; rises near the county line in southwestern part of Clay County; flows northerly along the boundary of Clay and Archer counties 11 miles, and empties into Little Wichita River (tributary to Red River and thus to the Mississippi).

Postoak Creek.—Bexar Couny; an intermittent stream in southwestern part of county; flows into Elm Creek (tributary to Medina River, and thus through San Antonio River into the Guadalupe). San Antonio topographic map.

Postoak Creek.—Jones County; a short intermittent stream; flows easterly into Clear Fork of Brazos (tributary to the Brazos) near western Shackelford County line. Anson topographic map.

Postoak Creek.—Kendall and Comal counties; rises north of Van Raub; flows through the southeastern part of Kendall and the extreme southwestern corner of Comal counties into Rio Cibolo and thus to San Antonio River (tributary to the Guadalupe).

Postoak Creek.—Grayson County; rises 5 miles northwest of Sherman; flows southeasterly 11 miles into Choctaw Creek (tributary to Red River and thus to the Mississippi) about 5 miles southeast of Sherman in eastern part of county. Denison topographic map.

Postoak Creek.—Matagorda County; rises in central part of county; flows southeasterly 3 miles into Cottonwood Creek (tributary to Gulf of Mexico through Prairie Creek, Liveoak Creek, Matagorda Bay and Gulf of Mexico).

Postoak Creek.—Menard County; a stream 6 miles long in the eastern part of county; flows to San Saba River, tributary to the Colorado.

Postoak Creek.—Navarro County; small stream flowing into Richland Creek (tributary to Trinity River) in western part of county.

Postoak Creek.—Shackelford and Callahan counties; rises near Crawford, flows northerly 30 miles into Deep Creek (tributary through Hubbard and Gonzales Creeks to Clear Fork of Brazos River and thus to the Brazos) 2½ miles north of Hulltown. Albany topographic map.

Postoak Creek.—Travis County; a tributary 5 miles in length flowing through Cow Creek into Colorado River in the northwestern part of the county. Burnet topographic map.

Pot Creek.—Fannin County; rises in southeastern part of county; empties into Brushy Creek (tributary to North Sulphur River, thence to Sulphur River and thus through Red River to the Mississippi).

Potter Creek.—Comal County; near Cranes Mill; small intermittent stream flowing through northeastern part of county into Guadalupe River.

Potter Creek.—Harrison County; rises about 3 miles northwest of Marshall; flows southerly 14 miles into Sabine River.

Potrance Creek.—Bexar County; rises northwest of Macdona in the western part of the county; flows into Medina River (tributary to San Antonio River thence to the Guadalupe); intermittent. San Antonio topographic map.

Powell or Lick Creek.—Cass County; rises about 3 miles east of Cusseta in northern part of county; flows northeasterly 9 miles into Sulphur River (tributary to Red River, which discharges into the Mississippi) about 1½ miles west of Pettes Bridge. About 2 miles south of its mouth the stream widens into Overcup Pond the outlet of which is known as Overcup Slough. Linden topographic map.

Powder Creek.—Fannin County; rises about 2 miles west of Bonham in central part of county; flows easterly 3 miles into Bois d'arc Creek (tributary to Red River which discharges into the Mississippi) about a mile east of Bonham.

Powderhorn Bayou.—Calhoun County; rises in the eastern part of the county; flows easterly 7 miles into Matagorda Bay and thus to Gulf of Mexico.

Powdermill Creek.—Burnet County; flows into Colorado River 2½ miles northeast of Kingsland in the southern part of the county; length, 3 miles. Burnet topographic map.

Prairie Bayou.—Nacogdoches County; small stream flowing into Bayou Pontizella (tributary to Bayou Atascosa, and thus through Bayou Carrizo to Angelina and Neches rivers) in eastern part of county.

Prairie Branch.—Cass County; rises about 4 miles west of T. P. sawmill; flows into Bee Creek (tributary to Johns Creek, thence through Frazier Creek to Caddo Lake and thus through Red River to the Mississippi) in northern part of county; intermittent.

Prairie Branch.—Montague and Clay counties; an intermittent stream flowing in Big Sandy Creek (tributary to West Fork of Trinity River, thence to the Trinity) in southeastern part of Clay County and southwestern part of Montague County. Montague topographic map.

Prairie Creek.—Anderson County; small stream flowing into Hurricane Creek (tributary to Neches River) in the eastern part of county.

Prairie Creek.—Camp County; rises about 5 miles south of Pittsburg; flows eastward 12 miles into Richland Creek (tributary to Big Cypress Creek and thus through Caddo Lake and Red River to the Mississippi) in the southeastern part of the county.

Prairie Creek.—Colorado County; rises in the western part of the county; flows southwesterly 3 miles into Navidad River (tributary to Lavaca River, thence to Matagorda Bay and Gulf of Mexico).

Prairie Creek.—Colorado County; rises at Weimar; flows southwesterly 6 miles into Navidad River (tributary to Lavaca River, thence to Gulf of Mexico through Matagorda Bay) near Lavaca-Colorado county line.

Prairie Creek.—Dallas County; rises 1 mile north of Arnold; flows southerly 11 miles into Trinity River about 1 mile north of Doddys Ferry. Dallas topographic map.

PRAIRIE CREEK.—Fayette County; in central part of county; tributary through Buckners Creek to Colorado River; length, 4 miles. Flatonia topographic map.

PRAIRIE CREEK.—Franklin County; rises at Mount Vernon in central part of county; flows northerly 6 miles into Whiteoak Bayou (tributary to Sulphur River and thus through Red River to the Mississippi).

PRAIRIE CREEK.—Hood and Somervell counties; an intermittent stream 4 miles in length flowing southerly into Paluxy Creek (tributary to Brazos River) 3 miles southeast of Paluxy in northwestern part of Somervell County. Granbury topographic map.

PRAIRIE CREEK.—Jasper County; rises near Jasper; headwater stream of Walnut Creek (tributary to Neches River); flows westerly 6 miles.

PRAIRIE CREEK.—Matagorda County; rises in the central part of the county; flows southeasterly 18 miles to its junction with Live Oak Creek, and thus to Matagorda Bay and Gulf of Mexico. About 1 mile above its mouth this stream forms a lake known as Lake Austin.

PRAIRIE CREEK.—Smith County; small stream flowing into Little Saline Creek (tributary to Sabine River) northwest of Winona in northern part of county.

PRAIRIE CREEK.—Smith and Gregg counties; rises about 12 miles east of Tyler in Smith County; flows easterly 14 miles into Sabine River in the western part of Gregg County about 5 miles southeast of Gladewater.

PRAIRIE CREEK.—Smith County; a southwesterly flowing stream 9 miles long emptying into Neches River northwest of Tyler in western part of county.

PRAIRIE CREEK.—Smith County; flows southerly 11 miles; empties into East Fork of Mud Creek (tributary to Mud Creek and thus through Angelina River to the Neches) in southeastern part of county.

PRAIRIE CREEK.—Shelby County; rises in central part of county; flows southerly 7 miles into South Tancha Bayou (tributary to Tancha Bayou and thus to Sabine River) about 2 miles north of Shelbyville.

PRAIRIE CREEK.—Terrell County; rises in southern part, 3 miles east of McClain Ranch; flows easterly; intermittent. Dryden Crossing topographic map.

PRAIRIE CREEK.—Upshur County; rises in northwestern part of county; flows southeasterly 9 miles into Little Cypress Creek (tributary to Caddo Lake, thence through Red River to the Mississippi) northwest of Gilmer.

PRAIRIE DOG TOWN FORK OF RED RIVER.—Curry County, N. Mex., Deaf Smith, Parker, Randall, Armstrong, Briscoe, Hall, Childress, Hardeman, and Wilbarger counties, Tex.; rises in "Head Breaks" of Red River about 20 miles west of the Texas-New Mexico boundary line, in northern part of Curry County, N. Mex.; flows easterly 280 miles to its junction with North Fork of Red River to form Red River (tributary to Mississippi River) about 2 miles east of Doans in northern part of Wilbarger County, Tex.

PRAIRIE MOUNTAIN SPRING BRANCH.—Llano County; a small intermittent stream flowing into Bullhead Creek and thus to Hickory Creek (tributary through the Llano to Colorado River) northeast of Starkes in the southwestern part of the county; length, 3 miles. Llano topographic map.

PRESCOTT CREEK.—Mills County; a stream 6 miles long joining Colorado River 2 miles south of Big Valley in the southern part of the county. San Saba topographic map.

PREWETTS CREEK.—Madison County; rises in southwestern corner of county; flows southwesterly 5½ miles into Navasota River (tributary to Brazos River) west of Cross.

PREWITT LAKE.—Cass County; northeast of Avinger; an expansion of Black Cypress Bayou (tributary to Big Cypress Bayou, thence through Caddo Lake to Red River and thus to the Mississippi). The lake is 1 mile long and 5 miles wide.

PRICE CREEK.—Collin County; rises 2 miles east of Copeville; flows southwesterly 6 miles into Sister Grove Creek (tributary to East Fork of Trinity River and thus to the Trinity) about a mile southeast of Clear Lake.

PRICES CREEK.—Dewitt County; rises 11 miles southeast of Cuero; flows through southeastern part of county into Guadalupe River.

PRICKLY PEAR CREEK.—Bastrop County; an intermittent stream rising near Royston Hill in the southern part of the county; flows southeasterly 5 miles into Borden Creek (tributary to Colorado River) near southeastern county line. Flatonia and Bastrop topographic maps.

PRICKLY PEAR CREEK.—Gonzales County; small intermittent stream flowing through town of Gonzales into Guadalupe River. Flatonia topographic map.

PRIETO CREEK.—Lasalle and Webb counties; rises in southeastern part of Webb County; flows northward 40 miles to its junction with Nueces River in La Salle County, a few miles below mouth of Salado Creek.

PROCELLA CREEK.—Angelina County; a stream 5 miles long flowing into Angelina River (tributary to Neches River) in the northwestern part of county.

PUENTE DE PIEDRA OR SULPHUR CREEK.—Live Oak and Bee counties; rises in the northwest corner of Bee County; flows southwesterly 9 miles through Bee County and 18 miles through Live Oak County into Nueces River about 1 mile west of Oakville.

PULLIAM CREEK.—Edwards County; a spring-fed creek, in the eastern part of the county; formed by the junction of Hackberry and Polecat Creeks; flows southeasterly 15 miles to its junction with East Nueces River, thence to Nueces River, 3 miles south of Barksdale. Nueces topographic map.

PURGATORY CREEK.—Hays County; south of the town of San Marcos; flows into San Marcos River and thence to Guadalupe River; intermittent. San Marcos topographic map.

PURTIS CREEK.—Van Zandt and Henderson counties; rises in southwestern part of Van Zandt County; flows southwesterly into Twin Creek (tributary to Cedar Creek, thence to Trinity River) in southwestern part of Henderson County.

QUAIL CREEK.—Donley County; small stream in northeastern part of county flowing into Whitefish Creek (tributary to Salt Fork of Red River and thus through Prairie Dog Town Fork of Red River to Red and Mississippi rivers).

QUAPAW CREEK.—Smith County; flows easterly 4 miles into Hays Creek (tributary through Prairie Creek to East Fork of Mud Creek, and thus through Mud Ceek to Angelina and Neches rivers) in southeastern part of county.

QUARRY CREEK.—Runnels County; southwest of Vale in western part of the county; flows into Valley Creek and thus to the Colorado; length, 10 miles. Hayrick topographic map.

QUEENS CREEK.—Dewitt County; small tributary to Guadalupe River in northern part of county near Hochheim.

QUICKSAND CREEK.—Newton County; rises about 6 miles southeast of Farrsville; flows southeasterly 14 miles into Sabine River.

QUIL MILLER CREEK.—Johnson County; rises 1½ miles southwest of Marystown; flows northerly 10 miles into Village Creek (tributary to West Fork of Trinity River, thence to the Trinity) about 2 miles south of Oak Grove, near the Tarrant-Johnson county line. Cleburne and Fort Worth topographic maps.

QUITAQUE CREEK.—Floyd and Motley counties; rises in northeastern part of Floyd County; flows northeasterly 20 miles into Pease River (tributary to Red River and thus to the Mississippi) in northern part of Motley County.

QUITMAN ARROYO.—El Paso County; an intermittent stream rising 8 miles west of Sierra Blanca and flowing southeasterly 33 miles into Rio Grande 28 miles southeast of Sierra Blanca. Sierra Blanca and Eagle Mountain topographic maps.

RABBIT CREEK.—Rusk and Gregg counties; rises about 2 miles north of Overton in Rusk County; flows northeasterly 17 miles into Sabine River in Gregg County about 3 miles southwest of Longview.

RABBITS EAR CREEK.—Dallam, Sherman, and Hansford counties; rises near Clayton, N. Mex., enters Texas near the northwestern corner of Dallam County and flows southeasterly to Sherman-Hansford county line, 15 miles east of Coldwater; thence takes a northeasterly course to Oklahoma-Texas State line, 23 miles northwest of Hansford; unites with Coldwater Creek (tributary to Beaver River thence through North Fork of Canadian River to the Canadian and thus through Arkansas River to the Mississippi) 9 miles southeast of Guymon, Okla.; intermittent.

RABBS CREEK.—Lee and Fayette counties; rises in the southern part of Lee County; flows southerly 7 miles through Lee County, then 9 miles through Fayette County to its junction with Colorado River 5 miles above Lagrange. Bastrop topographic map.

RACCOON CREEK.—Bowie County; a small stream about 3 miles southwest of New Boston flowing into Rice Creek (tributary through Anderson Creek to Sulphur River and thus through Red River to the Mississippi). New Boston topographic map.

RACE CREEK.—Young County; small stream flowing easterly 3 miles to a point 4 miles northwest of Proffitt in western part of Young County, where it enters Boggy Creek (tributary to Brazos River).

RAGGEDY CREEK.—Foard County; rises about 3 miles west of Crowell in northern part of county; flows northeasterly 10 miles into Pease River (tributary to Red River and thus to the Mississippi) about 3½ miles northwest of Margaret.

RAIN CREEK.—Bowie County; rises 1 mile southeast of Leary in eastern part of county; flows northerly into Big Creek (tributary to Red River, which discharges into the Mississippi). Texarkana topographic map.

RAINBOW CREEK.—Hunt County; rises about 4 miles west of Wolfe City in northern part of county; empties into South Sulphur River (tributary to Sulphur River and thus through Red River to the Mississippi).

RAINY CREEK.—Taylor County; rises 5 miles southeast of Elmdale; flows northwestward 12 miles into Lytle Creek (tributary through Elm Creek to Clear Fork of Brazos River and thus to the Brazos) 4 miles north of Abilene in northeastern part of county. Abilene topographic map.

RAIZ CREEK.—Nacogdoches County; flows southerly 5 miles into Nacoste Creek (tributary through Bayou Loco to Angelina River and thus to the Neches) in western part of county.

RANCH CREEK.—Mason County; a stream 6 m… northern part of the county to the west of… (tributary to Colorado River). Mason topog…

RANCHERIAS CANYON.—Presidio County; rises 4… flows southwesterly 8 miles into Rio Grande… in southern part of county. Polvo and Terli…

RANCHEROS OR COMANCHE CREEK.—Uvalde and Me… north of Sabinal; flows southeasterly and sou… River (tributary through Frio River to the… Sabinal.

RANDOLPH CREEK.—Guadalupe County; small inter… Salem School in the east-central part of the cou… and thus to Guadalupe River. San Marcos topo…

RANGE CREEK.—Grayson County; rises 4 miles south… southwesterly 13 miles to its confluence with Jord… Bois Creek (which discharges into Trinity Riv… the Trinity) about 3 miles south of Collinsville. …

RANNEY CREEK.—McLennan and Coryell counties; an… ing at Coryell City in northern part of Coryell Co… easterly 7 miles into Middle Bosque River (trib… thence through Bosque River to the Brazos) in the… nan County. Meridian topographic map.

RATTLESNAKE CREEK.—Montague County; about 2 miles… School; unites with Belknap Creek (tributary to Red… Mississippi) in northwestern part of county; intermit… topographic map.

RAVEN CREEK.—Fisher County; an intermittent stream ris… of Eskota and flowing northeasterly 9 miles into C… River (tributary to the Brazos) in southeastern corn… topographic map.

RAVEN CREEK.—Wheeler and Collingsworth counties; rises… part of Wheeler County; flows southeasterly 6 miles… Red River (tributary through North Fork of Red Riv… thus to the Mississippi) in northeastern part of Colling…

RAWHIDE CREEK.—Dallas County; small stream joining Farm… tary to Elm Fork of Trinity River and thus to the Trini… of Farmers Branch. Dallas topographic map.

RAW MEAT CREEK.—McMullen County; small stream flowing… Creek (tributary to Frio River and thus to the Nueces)… part of the county; length, 4 miles.

RAY CREEK.—Harrison County; rises about 2 miles northwes… central part of county; flows northwesterly 7 miles int… Bayou (tributary to Caddo Lake and thus through Re… Mississippi.)

REAGAN CANYON.—Brewster County; rises in southeastern… northeast of Dove Mountain; flows northeasterly, southweste… easterly 11 miles into Rio Grande; intermittent. Dove M… Gap, and Reagan Canyon topographic maps.

REBECCA CREEK.—Blanco and Comal counties; rises in southern… County; joins Guadalupe River in northern part of Comal… of Spring Branch.

RED ARROYO.—Hall County; rises in central part of country; flows northerly 8 miles into Little Red River (tributary to Prairie Dog Town Fork of Red River and thus through Red River to the Mississippi).

RED BAYOU.—Bowie County; about 8 miles north of Malta in northern part of county; takes an easterly course for 6¼ miles; connecting channel of a series of bends in Red River (tributary to Mississippi River).

RED BRANCH.—Lee County; a small intermittent stream flowing southward into Second Yegua Creek (tributary to Yegua Creek and thus to the Brazos) southeast of Lexington. Bastrop topographic map.

RED MOUNTAIN BRANCH.—San Saba County; a small intermittent stream in the southern part of the county; joins Pecan Creek (tributary through Llano River to the Colorado) 4 miles southwest of Taylorville; length, 3 miles. Llano topographic map.

RED CREEK.—Bowie County; rises about 2½ miles northwest of New Boston in northern part of county; flows northeasterly 8 miles into Red River (tributary to the Mississippi). New Boston topographic map.

RED CREEK.—Donley County; small stream flowing through eastern part of county into Salt Fork of Red River (tributary to Prairie Dog Town Fork of the Red and thus through the Red to the Mississippi).

RED BANK CREEK.—Garza County; rises in northwest part of county; flows easterly into North Fork of Double Mountain Fork of Brazos River (tributary to the Double Mountain Fork of the Brazos, thence to Brazos River).

RED BANK CREEK.—Parker and Hood counties; flows northerly 2½ miles into Brazos River 2 miles southeast of Buckner in southwestern part of county. Weatherford topographic map.

RED BANK CREEK.—Tom Green County; rises northeast of San Angelo; flows through the northeastern part of the county into Concho River and thus to the Colorado; length, 18 miles. Hayrick topographic map.

REDBUD CREEK.—Montague County; a small intermittent stream rising near Red Bud School and flowing to Farmers Creek (tributary to Red River and thus to the Mississippi) in northern part of county. Montague topographic map.

RED DEER CREEK.—Hemphill, Roberts, and Gray counties; rises near Pampa in northwestern part of Gray County; takes a northeasterly course through Roberts and Hemphill counties; flows into Canadian River (tributary to Arkansas River and thus to the Mississippi) a mile northwest of Canadian in northwestern part of Hemphill County; length, 35 miles.

RED FORK RUSH CREEK.—Eastland and Erath counties; rises 2 miles south of Rattlesnake Mountain in eastern part of Eastland County; flows northerly 11 miles into South Palo Pinto Creek (tributary through Palo Pinto Creek to Brazos River) 2 miles west of McQuirt Mountain. Stephenville topographic map.

REDGATES CREEK.—Colorado County; tributary through Cummins Creek to Colorado River in northern part of the county; length, 9 miles.

REDHOT CREEK.—Donley County, a stream 2 miles long flowing southerly through eastern part of county into McCormick Creek (tributary to Salt Fork of Red River and thus through Prairie Dog Town Fork of the Red to Red and Mississippi rivers).

REDMUD CREEK.—Donley County; a stream 2 miles long flowing southeasterly through eastern part of county into McCormick Creek (tributary to Salt Fork of Red River and thus through Prarie Dog Town Fork of the Red to Red and Mississippi rivers).

Redmud Creek.—Jones County; rises near Anson in central part of county; flows northeasterly 12 miles into California Creek (tributary to Clear Fork of Brazos River and thus to the Brazos) 4 miles west of Avoca; intermittent. Anson topographic map.

Redoak or Bullock Creek.—Dallas and Ellis counties; rises in the town of Cedar Hill in Dallas County; flows southeasterly 30 miles into Trinity River in the northeastern part of Ellis County. Dallas topographic map.

Redoak Creek.—Robertson County; small stream flowing southeasterly 7 miles into Navasota River (tributary to Brazos River) at the International and Great Northern Railway crossing in eastern part of county.

Redrock Creek.—Llano County; a stream 5 miles southwest of Bluffton in the eastern part of the county; flows 7 miles into Colorado River; intermittent. Burnet topographic map.

Red Gulley.—Bastrop County; northwest of Caldwell in the western part of the county; a small intermittent stream flowing into Moss Branch and thus through Dry Creek to Colorado River; length, 3 miles. Austin and Bastrop topographic maps.

Red Gulch.—Motley County; rises about 5 miles south of Northfield in northeastern part of county; flows northeasterly 4 miles into Sisk Creek (tributary to Pease River and thus through Red River to the Mississippi).

Redmond Branch.—Cooke County; small intermittent stream flowing to Pecan Creek (tributary through Elm Fork of the Trinity to Trinity River) southeast of the town of Gainesville. Gainesville topographic map.

Red River.—Formed in the southeastern part of Panhandle of Texas by the union of a number of headwater streams; Prairie Dog Town Fork, which drains the large area and is therefore considered the continuation of the main stream, rises in the extreme western part of Deaf Smith County, the watershed extending into New Mexico at an approximate elevation of 4,500 feet above sea level; from its source it takes a general southeasterly course about 200 miles, crosses the Plains and Panhandle counties of Texas, and flows to a point on the east line of Childress County where it intersects the Texas-Oklahoma boundary line, thence along the boundary between Texas and Oklahoma approximately 440 miles, and along the Texas-Arkansas State line 40 miles; from the northwestern corner of Texas the stream turns abruptly to the south, flows about 60 miles through a corner of Arkansas, thence approximately 220 miles through Louisiana entering Mississippi River in Avoyelles Parish, La. Area of drainage basin in Texas, 30,700 square miles. Principal tributaries in Texas: Sulphur, Wichita and Pease rivers, and Salt and North forks of Red River.

In its upper drainage across the Plains country the stream is but little more than a dry channel which in places is poorly defined and carries water only during times of heavy precipitation; its first perennial flow begins in Randall, Armstrong, and Briscoe counties and is derived from springs in the canyons which are cut to a depth of several hundred feet. East of Grayson County it passes through a timbered country of heavy precipitation and the flow of the stream is augmented by many tributaries until in the low lands of Louisiana, east of the Texas boundary, it becomes a maze of swamps.

Comparatively little economic use is made of its waters, the principal reason being that where water is needed for irrigation there is a deficient supply. Extensive use for power, irrigation and municipal purposes is made on some of its tributaries. Montague, Gainesville, and Denison topographic maps.

REED CREEK.—Gonzales County; a small intermittent stream in the northwestern part of the county flowing into Sandy Fork of Peach Creek (tributary to Peach Creek and thus to Guadalupe River) west of Thompsonville. Flatonia topographic map.

RED CREEK.—Gonzales County; south of Waelder in northern part of county; small intermittent tributary to Sandy Fork of Peach Creek, and thus through Peach Creek to Guadalupe River. Flatonia topographic map.

REED CREEK.—Llano County; an intermittent tributary to Little Llano River (and thus through Llano River to the Colorado) at Lone Grove in the northeastern part of the county; length, 5 miles. Llano topographic map.

REESE CREEK.—Bell County; an intermittent stream flowing southerly to a point 3½ miles west of Youngsport, where it enters Little River (tributary to the Brazos); length, 7 miles. Gatesville and Georgetown topographic maps.

RENHARDT BAYOU.—Harris County; rises 4 miles southwest of Humble; flows southeasterly 3½ miles into Garners Bayou and thus to Buffalo Bayou and Gulf of Mexico; intermittent. Humble topographic map.

RESACA CREEK.—Leon County; rises in northeastern part; flows northeasterly 7 miles into Buffalo Creek (tributary to Upper Keechi Creek, thence to Trinity River).

RESACA DE ENMEDIO.—Jim Wells County; a small tributary to Chiltipin Creek (thence to Gulf of Mexico through Pinias Creek, Santa Petronilla Creek, and Baffins Bay) in northern part of county.

RESLEY CREEK.—Erath and Comanche counties; rises near Dublin in southern part of Erath County; flows southeasterly 24 miles into Leon River (tributary through Little River to the Brazos) near Comanche-Hamilton County line, 2 miles north of Gentry Mill. Stephenville and Hamilton topographic maps.

REUBES CREEK.—Menard, Concho, and McCulloch counties; a stream joining South Brady Creek (tributary to Brady Creek and thus through San Saba River to the Colorado) 13 miles west of Brady in the southwestern part of McCulloch County; length, 13 miles. Eden topographic map.

REYNOLDS BRANCH.—Shackelford County; flows easterly 3½ miles to a point 1 mile north of Fort Griffin, where it enters Clear Fork of Brazos River (tributary to Brazos River) in northern part of county. Albany topographic map.

REYNOLDS CREEK.—Shackelford County; a stream flowing easterly 7 miles into Hubbard Creek (tributary through Gonzales Creek to Clear Fork of Brazos River and thus to the Brazos) at Greer Mountain southeast of Albany in southern part of county. Albany topographic map.

RHODA LAKE.—Armstrong County; about 7 miles southwest of Claude; an expansion of Mulberry Creek (tributary to Prairie Dog Town Fork of Red River and thus through Red River to the Mississippi); area, about three-fourths square mile.

RICARDO OR POLANS CREEK.—Val Verde County; an intermittent stream rising in the northeastern part of the county and flowing southerly approximately 10 miles into Devils River (tributary to Rio Grande).

RICES CANYON.—Brewster County; a canyon entering Tornilla Creek (tributary to Rio Grande) 6 miles northwest of Boquillas in southern part of county; flow intermittent. Chisos Mountain topographic map.

RICE CREEK.—Bowie County; rises about 3 miles northwest of New Boston; flows southeasterly 12½ miles into Anderson Creek (tributary to Sulphur River and thus through Red River to the Mississippi) about 2 miles west of Corley in southern part of county. New Boston topographic map.

RICHARDS OR TWELVEMILE CREEK.—Austin County; rises 2 miles northwest of Wallis; flows northeasterly 2 miles into Allens Creek (tributary to Brazos River) 1½ miles north of Wallis in southern part of county.

RICHARDSON CREEK.—Erath and Hood counties; rises 1 mile north of Bunker Hill in eastern part of Erath County; flows northeasterly 16 miles into Paluxy Creek (tributary to Brazos River), 1 mile northwest of the village of Paluxy. Stephenville and Granbury topographic maps.

RICHARDSON CREEK.—Collingsworth County; a stream 4 miles long flowing southerly through northwestern part of county into Willis Creek (tributary to Salt Fork of Red River and thus through Prairie Dog Town Fork of the Red to Red River, thence to the Mississippi).

RICHERSON LAKE.—Bowie County; about 3 miles south of Bassett in southwestern part of county; formed by old Sulphur River Channel (tributary to Red River and thus to the Mississippi).

RICHLAND CREEK, EAST FORK OF.—Delta County; rises 5 miles northwest of Cooper; flows southeasterly 6 miles into Richland Creek (tributary to South Sulphur River, thence through Sulphur River to Red River and thus to the Mississippi) about 1½ miles east of Cooper.

RICHLAND CREEK.—Hill, Navarro, and Freestone counties; rises 3½ miles east of Itasca in northern part of Hill County; flows easterly 50 miles into Trinity River in the northern corner of Freestone County. Cleburne topographic map.

RICHLAND CREEK.—Delta County; rises about 5 miles northwest of Cooper in western part of county; flows southeasterly 11 miles into South Sulphur River (tributary to Sulphur River, and thus through Red River to the Mississippi) about 5 miles southeast of Cooper.

RICHLAND CREEK.—Hopkins County; a stream in the eastern part of county flowing northerly 8 miles into Whiteoak Bayou (tributary to Sulphur River, and thus through Red River to the Mississippi).

RICHLAND CREEK, SOUTH FORK.—Hill and Navarro counties; small stream flowing into Richland Creek (tributary to Trinity River).

RICHLAND CREEK, NORTH FORK.—Hill and Navarro counties; rises in eastern part of Hill County; flows southeasterly into Richland Creek (tributary to Trinity River) in western part of Navarro County.

RICHLAND CREEK.—Goliad County; small tributary to Blanco Creek (thence to Gulf of Mexico through El Sarco River, Rio de la Mission and Copano Bay) in southwestern part of the county.

RICHLAND CREEK.—Sabine County; rises near the southern boundary of the county; flows northeasterly 8 miles into Sixmile Creek, and thus to Sabine River.

RICHLAND CREEK.—San Saba County; rises 4 miles south of Cowboy near the San Saba-McCulloch county line; flows southeasterly 23 miles through Richland Springs into San Saba River (tributary to the Colorado) 4½ miles northwest of San Saba. Brady and San Saba topographic maps.

RICHLAND CREEK.—Terrell County; rises about 20 miles south of Sheffield; flows through western part of county in a southeasterly direction 6 miles into Pecos River (tributary to Rio Grande) 18 miles south of Old Fort Lancaster and Sheffield.

RICHLAND CREEK.—Upshur and Camp counties; rises about 4 miles southwest of Lafayette in northern part of Upshur County; flows northeasterly 9 miles into Big Cypress Bayou (tributary to Caddo Lake, thence to Red River, and thus to the Mississippi) in southeastern part of Camp County.

Richmans Creek.—Polk County; small stream flowing into Bear Creek (tributary to Alabama Creek, and thus to Neches River) in the east central part of the county.

Rinard Creek.—Travis County; a small intermittent tributary in the southeastern part of the county flowing northward 4 miles from the town of Carl into Onion Creek, and thus to the Colorado. Austin topographic map.

Ringgold Creek.—Leon County; small stream flowing into Boon Creek (tributary to Trinity River) about 5 miles northwest of Navarro.

Rio Branch.—Cooke County; small intermittent stream flowing through southwestern part of county into Clear Creek, and thus through Elm Fork of Trinity River to the Trinity. Gainesville topographic map.

Rio Cibolo.—Kendall, Comal, Bexar, Guadalupe, Wilson, and Karnes counties; rises 8 miles northwest of Boerne in the southern part of Kendall County; flows southeasterly 12 miles through Kendall County, then along the boundary of Bexar and Comal counties for 30 miles; 27 miles along boundary of Guadalupe and Bexar, then 6 miles between Guadalupe and Wilson, thence 26 miles through Wilson, then 11 miles through Karnes into San Antonio River (tributary to the Guadalupe) near the town of Pana Maria in the central part of Karnes County.

Rio de la Mission.—Refugio County; formed near Refugio in the center of the county by union of El Sarco River and Medio Creek; flows southeastward 15 miles into Mission Bay (an arm of Gulf of Mexico through Copano Bay).

Rio Grande.—Rises near crest of Continental Divide, on eastern slope of San Juan Mountains, in the southwestern part of the State of Colorado; flows in general southeasterly, crosses the State of New Mexico, continues in a southeasterly course to a point east of Brownsville, Tex., where it enters the Gulf of Mexico. Drainage area in Texas, 20,700 square miles. Gaging stations near El Paso (1889–1893, 1895–1915), Fort Hancock (1900–1903), Langtry (1900–1914), Devils River, below mouth (1900–1914), Eagle Pass (1900–1914), near Laredo (1900–1914), Roma (1900–1914), Brownsville (1900–1914), and above and below Presidio (1900–1914).

This stream forms the international line between the United States and Mexico from a point a short distance above the city of El Paso to its mouth, a distance of approximately 900 miles. For the greater part of this distance it flows through picturesque rock canyons, emerging therefrom above its mouth, where it enters the delta. Frequently there is no flow at El Paso, but the tributaries below furnish water for lands in the lower drainage basin. Use is made of its waters for irrigation along its course, but water power is not developed. See Second Report of Texas Board of Water Engineers for list of certified filings for appropriations of water.

The principal tributaries are Pecos and Devils rivers, from the State of Texas.

The precipitation increases at a fairly uniform rate from a point near El Paso to the mouth of Pecos River, ranging from 9 to 19 inches; from this point it increases rapidly, reaching 25 inches at the mouth of the stream. El Paso, Rio Grande, Fort Hancock, Eagle Mountain, Chispa, San Carlos, Ruidosa, Shafter, Polvo, Terlingua, and Chisos Mountain topographic maps.

Ripley Creek.—Franklin and Titus counties; rises 3 miles south of Mount Vernon in the eastern part of Franklin County; flows northeasterly 11 miles into Whiteoak Bayou (tributary to Sulphur River and thus through Red River to the Mississippi) in northwestern part of Titus County.

RIPPY BRANCH.—Parker County; Rises in northwestern part of county; flows southwesterly 7 miles into Rock Creek (tributary to Brazos River) one-half mile west of Blue Spring. Weatherford and Palo Pinto topographic maps.

ROARK CREEK.—Cherokee County; small stream emptying into Angelina River (tributary to the Neches) north of Forest in southeastern part of county.

ROBERTS CREEK.—Floyd and Motley countries; rises in northeastern part of Floyd County; flows northeasterly 8 miles into Quitaque Creek (tributary through Pease River to the Red and thus to Mississippi River) in northwestern part of Motley County.

ROAN GULLY.—Harris County; rises in northwestern part of county 1 mile southeast of Hufsmith; flows southeasterly 2 miles into Willow Creek (tributary to Spring Creek, San Jacinto River, and thus through Galveston Bay to Gulf of Mexico); intermittent. Louetta topographic map.

ROBERTSON BAYOU.—Chambers County; a small tidal stream in the southern part of the county; takes an irregular southeasterly course into East Galveston Bay; thence to Gulf of Mexico; length, 3 miles.

ROBERTSON CREEK.—Nolan County; rises west of Hylton in the southeastern part of the county; flows 8 miles into Oak Creek (tributary to Colorado River). Sweetwater topographic map.

ROBINSON BRANCH.—Johnson County; rises 2 miles northwest of Bono in western part of county; flows southeasterly 7 miles into Nolands River (tributary to the Brazos) southwest of Cleburne. Granbury and Cleburne topographic maps.

ROBINSON BRANCH.—Burnet County; small stream flowing 2½ miles northerly into Russell Fork of San Gabriel River (tributary through the North Fork of San Gabriel River to the San Gabriel and thus to Little and Brazos rivers) northeast of Burnet. Burnet topographic map.

ROBINSON CREEK.—Hood County; rises near Erath-Hood County line; flows northeasterly 15 miles into Brazos River, 3 miles north of Thorps Springs in northern part of county. Granbury and Weatherford topographic maps.

ROBINSON CREEK.—Jasper County; a stream 6 miles long flowing southwesterly into Big Creek (tributary to Neches River) in western part of county.

ROBISON CREEK.—Fayette County; small intermittent tributary joining Colorado River 1½ miles northwest of West Point in the northwestern part of the county; length, 4 miles. Flatonia topographic map.

ROCHELLE CREEK.—Bowie County; an intermittent stream 3 miles long flowing southeasterly to its junction with Langum Creek (tributary to Sulphur River and thus through Red River to the Mississippi) about 3 miles southeast of Redwater in southeastern part of county. Texarkana topographic map.

ROCK BAYOU.—Harris County; rises in the northwestern part of the county; flows easterly and northeasterly 21 miles into Cypress Creek (tributary through Spring Creek to San Jacinto River and thus to Galveston Bay and Gulf of Mexico) 5 miles east of Cypress.

ROCK CREEK.—Cooke County; a small stream flowing into Pecan Creek (tributary through Elm Fork of Trinity to the Trinity) northwest of the town of Gainesville. Gainesville topographic map.

ROCK CREEK.—Smith County; a stream about 6 miles long flowing northeasterly into Sabine River about 3 miles west of point where the International & Great Northern Railroad crosses this stream in northwestern part of county.

ROCK CREEK.—Bosque County; a stream 4½ miles long flowing northerly into Brazos River at Brazos Point, in extreme northern part of county. Granbury topographic map.

ROCK CREEK.—Bowie County; rises about 1½ miles southwest of Whaleys; flows southerly 7 miles into Langum Creek (tributary to Sulphur River and thus through Red River to the Mississippi) about 1½ miles northwest of Maud, in central part of county. New Boston topographic map.

ROCK CREEK.—Gonzales County; small stream in southern part of the county; flows into Elm Fork of Sandies Creek (tributary to Sandies Creek and thus to Guadalupe River.)

ROCK CREEK.—Goliad County; small stream in northwestern part of county flowing through Coleto Creek to Guadalupe River.

ROCK CREEK.—Grayson County; small intermittent stream flowing into Red River (tributary to Mississippi) in extreme northwestern part of county. Denison topographic map.

ROCK CREEK.—Gregg County; small tributary to Prairie Creek and thus to the Sabine River in western part of county.

ROCK CREEK.—Hopkins County; rises about 4 miles south of Sulphur Springs; flows northeasterly 9 miles into Whiteoak Bayou (tributary to Sulphur River and thus through Red River to the Mississippi).

ROCK CREEK.—Jack and Palo Pinto counties; a stream flowing southerly 13 miles along the west line of Jack County to its junction with Brazos River, three-fourths of a mile east of southeast corner of Young County. Palo Pinto topographic map.

ROCK CREEK.—Hutchinson and Carson counties; an intermittent stream rising 10 miles north of Panhandle, in northern part of Carson County, and flowing northerly into Canadian River (tributary through Arkansas River to the Mississippi) 6 miles southwest of Plemons, in southwestern part of Hutchinson County.

ROCK CREEK.—Johnson and Tarrant counties; rises north of Brushy Knob, in Johnson County; flows northerly 12 miles into Clear Fork of Trinity River (tributary to West Fork of Trinity River and thus to the Trinity) about 4 miles south of Benbrook. Cleburne and Fort Worth topographic maps.

ROCK CREEK.—Lamar County; rises about a mile southwest of Brookston, in southwestern part of county; flows southeasterly 11 miles into North Sulphur River (tributary through Sulphur River to Red River and thus to the Mississippi), in southwestern part of county, at southern boundary.

ROCK CREEK.—McLennan County; rises about 2 miles north of China Springs, in western part of county; flows northeasterly 8 miles into Brazos River. Waco topographic map.

ROCK CREEK.—Parker and Jack counties; rises in southeast corner of Jack County; flows southerly 24 miles into Brazos River 4 miles southwest of Millsap in western part of Parker County. Weatherford and Palo Pinto topographic maps.

ROCK CREEK.—Uvalde County; intermittent stream in northern part of county; flows southeastward 7 miles to its junction with Dry Frio River (tributary to the Nueces through Frio River) 1 mile south of Davenport ranch. Uvalde topographic map.

ROCK FORK OF NAVIDAD RIVER.—Fayette County; rises east of the town of Flatonia; flows eastward 9 miles into West Fork Navidad River (tributary through Navidad River to the Lavaca and thence to Matagorda Bay and Gulf of Mexico) 3 miles west of Schulenburg. Flatonia topographic map.

ROCKPOOL GULLY.—Harris County; rises 5½ miles east of Moonshine Hill; flows northeasterly 1½ miles into San Jacinto River and thus to Gulf of Mexico. Intermittent. Moonshine Hill topographic map.

ROCK SPRINGS CREEK.—Gray and Donley counties; rises in southern part of Gray County; flows southeasterly 8 miles into Whitefish Creek (tributary to Salt Fork of Red River, Prairie Dog Town Fork of Red River, and thus through Red River to the Mississippi), in northeastern part of Donley County.

ROCK TANK CREEK.—Johnson County; small stream flowing into South Fork of Pecan Creek (tributary to Pecan and Richland creeks, thence to the Trinity) southeast of Cuba, in eastern part of county. Cleburne topographic map.

ROCKHOUSE DRAW.—El Paso County; an intermittent stream in central part of county near southern edge of Hueco Mountains; flows southerly 9 miles and sinks in the sands 27 miles north of Fort Hancock. Cerro Alto topographic map.

ROCKWALL CREEK.—Scurry County; rises in northeast corner of county; flows northeasterly 5 miles into Rough Creek (tributary through Double Mountain Fork of Brazos River to the Brazos).

ROCKY BRANCH.—Gregg County; small tributary to Sabine River about 3 miles west of Longview.

ROCKY BRANCH.—Hill County; a small intermittent stream flowing southerly into Hackberry Creek (tributary to Aquilla Creek and thus to Brazos River) in central part of county southwest of Hillsboro. Waco topographic map.

ROCKY CREEK.—Bastrop County; northwest of Cistern in southern part of county; small intermittent stream flowing into Peach Creek and thus to Guadalupe River. Flatonia topographic map.

ROCKY CREEK.—Burnet County; formed 4½ miles southwest of Oakalla in northeastern corner of county by union of North and South Rocky creeks; flows northeasterly 5½ miles into Lampasas River (tributary through Little River to the Brazos) one-half mile northeast of Oakalla. Georgetown topographic map.

ROCKY CREEK.—Bell County; rises near Bell-Williamson county line; flows northerly 5 miles into Lampasas River (tributary through Little River to the Brazos) southwest of Youngsport. Georgetown topographic map.

ROCKY CREEK.—Bosque County; a stream flowing easterly 10 miles into Brazos River west of Prairie Valley in eastern part of county. Waco topographic map.

ROCKY CREEK.—Cass County; rises about 4 miles west of Forest; flows northeasterly 5 miles into Sulphur River (tributary to Red River and thus to the Mississippi).

ROCKY CREEK.—Colorado County; small stream in western part of county; flows southerly 5 miles joining Colorado River 4 miles west of Columbus.

ROCKY CREEK.—Comanche County; a small intermittent stream; rises near Comanche-Hamilton County line south of Carleton; flows southerly 4 miles into Resley Creek (tributary to Leon River, thence through Little River to the Brazos). Hamilton topographic map.

ROCKY CREEK.—Fayette County; rises near Rutersville; joins Colorado River in the eastern part of the county 4 miles east of LaGrange; length, 9 miles.

ROCKY CREEK.—Fayette County; tributary through Cummins Creek to Colorado River in the northeastern part of the county; flows one mile to the east of Roundtop; length, 8 miles.

ROCKY CREEK.—Fayette County; an intermittent stream rising two miles northeast of Flatonia, and flowing southeasterly to its junction with Mulberry Creek (thence to Navidad and Lavaca rivers and Gulf of Mexico) near the southern county line. Flatonia topographic map.

ROCKY CREEK.—Garza and Scurry counties; rises in northwestern corner of Scurry County; flows northerly 8 miles into Double Mountain Fork of Brazos River (which discharges into Brazos River).

ROCKY CREEK.—Gonzales County; southeast of Gonzales in the eastern part of the county; small intermittent stream flowing into Peach Creek (tributary to Guadalupe River).

ROCKY CREEK.—Grimes County; small intermittent stream flowing into Beasom Creek (tributary to Brazos River) east of Courtney in southern part of county. Navasota topographic map.

ROCKY CREEK.—Irion County; rises in the northern part of the county; flows southeastward about 17 miles into Middle Concho River (tributary to South Concho, and thus through Concho River to the Colorado) 1 mile south of Arden in the northeastern part of the county. Sherwood topographic map.

ROCKY CREEK.—Kaufman County; small stream flowing into Ferris Fork of Cedar Creek (tributary to Cedar Creek and Trinity River) in eastern part of county.

ROCKY CREEK.—Lavaca County; rises 4 miles west of Shiner near Lavaca-Gonzales county line; flows southeasterly 23 miles into Lavaca River (thus to Gulf of Mexico through Matagorda Bay) 7 miles south of Hallettsville.

ROCKY CREEK.—Llano County; an intermittent stream 3 miles in length flowing into Llano River (thence to Colorado River) northwest of Packsaddle in the southeastern part of the county. Llano topographic map.

ROCKY CREEK.—Miller County, Ark., and Bowie County, Tex., rises in Miller County, Ark., about 3½ miles southeast of Texarkana; flows southwesterly 3 miles to its intersection of the Texas-Arkansas state line about 3½ miles south of Texarkana, thence 1 mile through Bowie County, Tex., into Hurricane Creek (tributary to Sulphur River and thus through Red River to the Mississippi). Texarkana topographic map.

ROCKY CREEK.—Palo Pinto County; a stream flowing southeasterly 8 miles into Palo Pinto Creek (tributary to Brazos River) near Mingus in southwestern part of county. Palo Pinto topographic map.

ROCKY CREEK.—Palo Pinto County; a stream 7 miles long flowing southerly into Brazos River, 4 miles southeast of Brazos, in southeastern part of county. Palo Pinto topographic map.

ROCKY CREEK.—Wilbarger County; rises about 3 miles west of Harrold in eastern part of county; flows southerly 7 miles into Beaver Creek, thence to Wichita River, and thus through Red River to the Mississippi.

ROCKY CREEK.—Schleicher and Menard counties; a stream 15 miles long in the western part of Menard County; empties into San Saba River (tributary to the Colorado) 9 miles northeast of Fort McKavett. Fort McKavett topographic map.

ROCKY CREEK.—Washington County; rises 3 miles southwest of Independence in northern part of county; flows southeasterly 12 miles into Brazos River. Gay Hill topographic map.

ROCKY FORK OF NAVIDAD RIVER.—Lavaca County; rises near Novohrall in northwestern part of county; flows southeasterly 15 miles into Navidad River (tributary to Lavaca River, thence to Gulf of Mexico through Matagorda Bay) in northeastern part of county.

RODAIR BAYOU.—Jefferson County; small tidal stream rising about 1 mile southwest of Delphine; and flowing southwesterly 3 miles into Taylors Bayou (and thus through Sabine Lake to Gulf of Mexico) about one-half mile below mouth of Hillebrant Bayou.

RODGERS CREEK.—Wood and Upshur counties; rises in southeastern part of Wood County; flows southeasterly 6 miles into Sabine River in southwestern part of Upshur County.

ROGERS CREEK.—Harrison and Panola counties; rises in southern part of Harrison County; flows southerly 4 miles to its junction with Tuttle Creek in northwestern part of Panola County, where it forms Jackson Creek (tributary to Sabine River).

ROGERS OR SIXMILE CREEK.—Leon and Madison counties; rises in southeastern part of Leon County; flows easterly 9 miles, forming a loop in the northeastern corner of Madison County; joins Trinity River in Leon County about a mile southwest of Commerce.

ROGERS GULLY.—Harris County; rises 1 mile north of Harmaston; flows easterly 2 miles into San Jacinto River (tributary to Gulf of Mexico); intermittent. Harmaston topographic map.

ROLLING FORK.—Harris County; rises in northwestern part of county; 3½ miles east of Satsuma; flows southerly 2 miles into Whiteoak Bayou, thence to Buffalo Bayou and Gulf of Mexico; intermittent. Satsuma topographic map.

ROSALIA CREEK.—Duval County; small intermittent stream in southwestern part of county; flows eastward 8 miles to its junction with Parilla Creek (tributary to Gulf of Mexico through Poquita Creek and Baffins Bay).

ROSALES OR CHACON CREEK.—Frio and Medina counties; rises in the eastern part of Medina County; flows southerly 18 miles through Medina County, then 17 miles through Frio County into San Miguel Creek (tributary to the Nueces through Frio River); length, 36 miles.

ROSILLO CREEK.—Bexar County; rises north of Kerby in the eastern part of the county; flows southerly 16 miles into Salado Creek (tributary to San Antonio River and thus to the Guadalupe) 2½ miles east of Espada Mission. San Antonio topographic map.

ROSITA CREEK.—Jim Wells County; small tributary to Agua Dulce Creek (thence to Gulf of Mexico through Santa Petronilla Creek and Baffins Bay) in northeastern part of the county; flows northeasterly.

ROSS OR WEAVER CREEK.—Bowie County; rises about 5 miles southeast of De Kalb; flows southerly 8 miles into Bassett Creek (tributary to Sulphur River and thus through Red River to the Mississippi) about 2½ miles northwest of Bassett in western part of county.

ROSS CREEK.—Sterling and Mitchell counties; rises in the northeastern part of Sterling County; flows northeasterly 16 miles into Colorado River in the southern part of Mitchell County.

ROUGH CREEK.—Bosque and Somervell counties; rises in southwestern corner of Somervell County; flows southeasterly into East Bosque River (tributary to Bosque River and thus to the Brazos) 3 miles west of Walnut in the western part of Bosque County. Granbury topographic map.

ROUGH CREEK.—Coleman County; rises near Novice in the northwestern part of county; flows 11 miles to its junction with Jim Ned Creek, and thus through Pecan Bayou to the Colorado. Ballinger and Abilene topographic maps.

ROUGH CREEK.—Coke County; a short stream flowing southwesterly into Colorado River about 8 miles northwest of Robert Lee.

ROUGH CREEK.—Erath County; northerly flowing stream 3 miles long joining North Paluxy Creek (tributary to Paluxy Creek and thus to Brazos River) 3½ miles southwest of Morgans Mill in northern part of county. Stephenville topographic map.

ROUGH OR SWEETWATER CREEK.—Fisher and Scurry counties; rises near Dermott in northern part of Scurry County; flows northeasterly 22 miles into Double Mountain Fork of Brazos River tributary to the Brazos) near Adair in northwest corner of Fisher County.

ROUGH CREEK.—Mills County; small stream northwest of Regency in the southwestern part of the county; flows 5 miles into Colorado River. Brownwood and San Saba topographic maps.

ROUGH CREEK.—San Saba County; small stream northwest of Bend in the southeastern part of the county; tributary to Colorado River; length, 8 miles. San Saba topographic map.

ROUGH CREEK.—Somervell County; rises 2 miles northwest of Chalk Mountain; flows northerly 7 miles into Paluxy Creek (tributary to Brazos River) 3 miles southeast of Paluxy in western part of county. Granbury topographic map.

ROUGH HOLLOW.—Uvalde County; small intermittent tributary to West Nueces River west of Round Mountain; 4½ miles long. Brackett topographic map.

ROUGH HOLLOW.—Kinney County; a small intermittent tributary to West Nueces River (thence to Nueces River) rising at Turkey Mountain and flowing southeasterly through the northeastern part of the county; length, 7 miles. Brackett topographic map.

ROUGH RUN.—Brewster County; rises on eastern slope of Christmas Mountains; flows southwesterly 15 miles; joins Terlingua Creek (tributary to Rio Grande) 10 miles east of Terlingua. Terlingua topographic map.

ROUND HOLE BRANCH.—Erath County; rises 2 miles south of Selden in southern part of county; flows southerly 4 miles into Bosque River (tributary to the Brazos) near Clairette. Stephenville topographic map.

ROUND LAKE.—Bowie County; about 5 miles southeast of Maud in southern part of county; formed by an old channel of Sulphur River (tributary to Red River, which discharges into the Mississippi). New Boston topographic map.

ROUND LAKE.—Fort Bend County; 8 miles northeast of Richmond in northern part of county; outlet, Oyster Bay, which discharges into Brazos River; small.

ROUND-UP CREEK.—Collingsworth County; a stream 3½ miles long flowing southerly through eastern part of county into Salt Fork of Red River, thence to Prairie Dog Town of the Red, and thus through Red River to the Mississippi.

ROWLETT CREEK.—Collin, Dallas, and Rockwall counties; rises about 4 miles west of Allen in Collin County; flows southeasterly 26 miles into East Fork of Trinity River (tributary to Trinity River) in the southwestern part of Rockwall County a short distance above Barnes Bridge. Dallas and Barnes Bridge topographic maps.

RUCKER CREEK.—Hood County; rises near Parker-Hood county line; flows southerly 11 miles into Brazos River at Granbury in northeastern part of county. Weatherford and Granbury topographic maps.

RUNNING BRUSHY CREEK.—Williamson County; rises in southeastern part of county 1½ miles west of Brugerhoff; flows easterly 12 miles into Brushy Creek, tributary to San Gabriel River. Georgetown topographic map.

RUMMEL CREEK.—Harris County; rises 1½ miles northwest of Hillendahl; flows southwesterly 3½ miles into Buffalo Bayou (tributary to Sabine, Trinity, and Galveston bays, and thus to Gulf of Mexico); intermittent. Hillendahl topographic map.

RUNEY CANYON.—Jeff Davis County; a stream 6 miles in length connecting with Horse Thief Canyon (tributary to Limpia Creek, and thus through Paisano Creek and Pecos River to Rio Grande) in eastern part of county. Fort Davis topographic map.

RUNNING CREEK.—Hopkins and Wood counties; rises in southern part of Hopkins County; flows southerly 14 miles into Caney Creek in northwestern part of Wood County.

RUNNING FORK.—Shelby County; headwater stream of Patroon Bayou (tributary to Sabine River) southeast of Neuville in southern part of county.

RUSH CREEK.—Armstrong County; in northwestern part of county; an interrupted intermittent water course that probably, during extremely heavy precipitation, flows southwesterly about 9 miles into Dry Creek (tributary to Prairie Dog Town Fork of Red River and thus through the Red to Mississippi River).

RUSH CREEK.—Navarro County; rises near Powell in eastern part of county; flows southeasterly 16 miles into Trinity River.

RUSH CREEK.—Rockwall County; an intermittent stream flowing into East Fork of Trinity River (tributary to the Trinity) southwest of Heath in the southwestern part of the county. Barnes Bridge topographic map.

RUSH CREEK.—Sabine County; flows southwesterly 6 miles into Devils Ford Creek (then to Bear Creek, Ayish Bayou, Angelina, and Neches rivers) in southwestern part of county.

RUSH CREEK.—Tarrant County; rises about 3½ miles southeast of Kennedale; flows northerly 11 miles into Village Creek (tributary to West Fork of Trinity River, and thus to the Trinity) 4 miles west of the town of Arlington. Fort Worth topographic map.

RUSH CREEK.—Wichita County; a small stream flowing into Wichita River (tributary to Red River and thus to the Mississippi) in the southwestern part of the county.

RUSH LAKE.—Fort Bend County; in northern part of county 6½ miles northeast of Richmond in Oyster Bayou drainage; outlet, Oyster Bay and Brazos River; small.

RUSKS BROOK.—Nacogdoches County; small stream flowing into Bayou Bonito (tributary to Bayou La Nana, and thence to Angelina and Neches rivers) in the town of Nacogdoches.

RUSTLERS CREEK.—Dickens and Motley counties; rises in northwestern corner of Dickens County; flows northeasterly 5 miles into Wolf Creek (tributary to Olive Fork of South Pease River and thus through South Pease, Middle Pease, and Pease rivers to Red River, which discharges into the Mississippi) about a mile north of the southern boundary line in southwestern part of Motley County.

RUSSELL CREEK.—Palo Pinto, Stephens, and Eastland counties; rises 5 miles east of Merriman in northern part of Eastland County; flows northeasterly 10 miles into North Palo Pinto Creek (which discharges into Brazos River through Palo Pinto Creek) 4 miles west of Strawn in southwestern part of Palo Pinto County. Eastland and Breckenridge topographic maps.

RUSSELL CREEK.—Hopkins County; small stream flowing into Whiteoak Bayou (tributary to Sulphur River and thus through Red River to the Mississippi) about 4 miles northwest of Sulphur Springs in central part of county.

Russell Creek.—Tyler and Polk counties; rises about 3 miles east of Hortense in Polk County; flows northeasterly 17 miles into Neches River in Tyler County about 7 miles west of Rockland.

Russell Fork of San Gabriel River.—Burnet County; rises 5 miles north of Burnet in central part of county; flows easterly 17 miles into North Fork of San Gabriel River (tributary to San Gabriel River and thus through Little River to the Brazos) a mile southeast of Joppa. Burnet topographic map.

Sabanna River.—Comanche, Eastland and Callahan counties; rises near the village of Atwell near to Eastland and Callahan county line; flows southeasterly 50 miles into Leon River (tributary to Little River and thus to the Brazos) 6 miles south of Deleon in northern part of Comanche County. Eastland topographic map.

Sabina Creek.—Kendall County; near Welfare in central part of county; small tributary to Guadalupe River.

Sabinal River.—Bandera and Uvalde counties; rises near Vanderpool in the western part of Bandera County; flows southward and southeastward 18 miles through Bandera County, then 40 miles through Uvalde County into Frio River (tributary to the Nueces) in southeast corner of Uvalde County. Uvalde topographic map.

Sabinas Creek.—Kendall County; east of Comfort; tributary to Guadalupe River in western part of county.

Sabine River.—Rises about 3 miles northeast of Farmersville in Collin County in the northeastern part of the State; flows southeasterly 180 miles to the southeastern corner of Panola County, then takes a southerly course, forming the boundary between Texas and Louisiana for 180 miles; empties into Sabine Lake (an expansion of Sabine River in Orange County 13 miles below Orange, and thus through Sabine Pass to the Gulf of Mexico. Gaging stations at Longview, Tex., (1904–1906), Logansport, La., (1903–1906).

The river is navigable for small boats for some distance above its mouth, and commercially is of great value.

As the Sabine has its sources and watershed in a region of abundant rainfall, as well as a forest cover which conserves the run-off, it is fed by many strong flowing tributaries, many of which are utilized for small water-power plants. Rice is irrigated in the lower portion of the drainage. Area of drainage basin in Texas, 7,360 square miles. See Second Report of Texas Board of Water Engineers for list of certified filings for appropriation of water.

Sabine River, Lake Fork of.—Hopkins, Rains, and Wood counties; rises about 1 mile north of Daisy, in southwestern part of Hopkins County; flows southeasterly 44 miles into Sabine River about 1½ miles southwest of Crow, in southern part of Wood County.

Sabinillo Creek.—Sabine County; rises in northwestern part; flows southeasterly 6 miles into Palo Gaucho Bayou (tributary to Sabine River).

Sabine Lake.—Orange and Jefferson counties; heads 13 miles southwest of Orange; an expansion of Sabine River at its mouth; about 19 miles long and 6 miles wide; approximate area, 115 square miles; outlet through Sabine Pass (tidal channel about 8 miles long) to Gulf of Mexico; tidal. The Texas-Louisiana boundary line follows the center of Sabine Lake.

Saddlers Creek.—Donley County; rises about 2 miles southeast of Evans, in the northern part of the county; flows southerly 12 miles into Salt Fork of Red River (tributary to Prairie Dog Town Fork of the Red and thus through Red River to the Mississippi) 8 miles northwest of Clarendon.

SADDLE CREEK.—McCulloch County; in the northwestern part of the county; flows 7 miles to its junction with Salt Creek (tributary to the Colorado). Eden topographic map.

SAGE DRAW.—Dickens County; small stream flowing southward 7 miles into Duck Creek (tributary through Salt Fork of Brazos River to the Brazos) south of Gilpin, near Dickens-Kent county line.

ST. CLAIR CREEK.—Roberts County; rises 6 miles northwest of Miami; flows northerly 15 miles into Canadian River (tributary to Arkansas River and thus to the Mississippi) 22 miles northwest of Miami, in northeastern part of county.

SALADO CREEK.—Bexar County; rises near Van Raub, in the northern part of the county; flows southerly 38 miles into San Antonio River (tributary to the Guadalupe) 3 miles south of Espada Mission. San Antonio topographic map.

SALADO CREEK, NORTH FORK.—Bell and Williamson counties; small stream flowing northeasterly into Salado Creek (tributary to Lampasas River and thus through Little River to the Brazos) south of Youngsport; length, 7 miles. Georgetown topographic map.

SALADO CREEK.—Williamson and Bell counties; rises 4 miles northwest of Florence, in northern part of Williamson County; flows northeasterly 35 miles into Lampasas River (tributary through Little River to the Brazos) 1 mile above mouth of Lampasas River. Georgetown and Taylor topographic maps.

SALADO CREEK.—Webb and Lasalle counties; rises in the northeastern part of Webb County; flows northeasterly 15 miles through Webb County, then 1 mile through Lasalle County into Nueces River, in southeastern corner of Lasalle County.

SALAVILLA CREEK.—Bexar County; rises southeast of Converse, in the eastern part of the county; empties into Martinez Creek (tributary to Rio Cibolo, thence through San Antonio River to the Guadalupe).

SALES BRANCH.—Tom Green County; an intermittent stream 5 miles long southwest of the town of Miles, in the northeastern part of the county; flows into Concho River and thus to the Colorado. Hayrick topographic map.

SALINAS CREEK.—Mason County; a stream 12 miles long flowing through the western part of the county to its junction with Llano River (tributary to the Colorado) south of Indianapolis. Mason topographic map.

SALINAS CREEK.—Refugio and Aransas counties; rises in the eastern part of Refugio County; flows southeasterly 2 miles through Refugio County, then 3 miles through Aransas County into St. Charles Bay, and thus to Aransas Bay and Gulf of Mexico.

SALINE OR CARTERS CREEK.—Brazos County; rises near Bryan, in central part of county; flows southeasterly 16 miles into Navasota River (tributary to Brazos River).

SALINE CREEK.—King County; a small stream flowing 5 miles west of Guthrie into South Wichita River, thence to Wichita River, and thus through the Red to the Mississippi.

SALINE FORK OF CROTON CREEK.—King County; considered continuation of Croton Creek; see also Croton Creek.

SALLIE KEATON SLOUGH.—Cass County; about 5 miles northeast of Douglasville; formed by an old channel of Sulphur River; during overflow connects Shoal Creek with Sulphur River (tributary to Red River, which discharges into the Mississippi); intermittent. Linden and New Boston topographic maps.

SALSAMORA CREEK.—Bexar County; rises north of the city of San Antonio; flows southeasterly 12 miles into San Pedro Creek (tributary through San Antonio River to the Guadalupe), in the southwestern part of San Antonio. San Antonio topographic map.

SALT BAYOU.—Jefferson County; rises in Star Lake about midway between Sabine Pass and west county line; flows northwesterly parallel to the Gulf shore, passes through lakes Kieth, Salt, Knight, and Fence, as well as a number of shallow lakes, then takes a northerly course, discharging into Taylors Bayou, and thus through Sabine Lake to the Gulf of Mexico, near West Port Arthur.

SALT BRANCH.—Erath County; an intermittent stream south of Dublin in southern part of county; flows southerly 4 miles into Resley Creek (tributary to Leon River and thus through Little River to the Brazos). Stephenville and Hamilton topographic maps.

SALT BRANCH.—Fayette County; south of Muldoon in western part of the county; a small intermittent stream about 2 miles long flowing into Pinoak Creek (tributary through Buckner Creek to Colorado River). Flatonia topographic map.

SALT BRANCH.—Karnes County; near Runge, in the eastern part of the county; flows through Ecleto Creek to San Antonio River and thus to the Guadalupe.

SALT BRANCH.—San Saba County; rises near Taylorville in the southeastern part of the county; flows northeasterly 7 miles into Cherokee Creek (tributary to Colorado River) 3½ miles northeast of the town of Cherokee. Llano and San Saba topographic maps.

SALT BRANCH OF SALT CREEK.—Concho and McCulloch counties; a small stream flowing through the northwestern part of McCulloch and northeastern part of Concho County into Salt Creek and thus to the Colorado; length, 11 miles. Eden topographic map.

SALT CREEK.—Armstrong County; rises in southwestern part of county; flows southwesterly 6 miles into Prairie Dog Town Fork of Red River (tributary to Red River, and thus to the Mississippi).

SALT CREEK.—Brown County; rises northeast of the town of Brownwood in the eastern part of the county; flows into Pecan Bayou (tributary to Colorado River); length, 11 miles. Brownwood topographic map.

SALT CREEK.—Collingsworth and Childress counties; rises in southwestern part of Collingsworth County; flows southeasterly 23 miles into Prairie Dog Town Fork of Red River (tributary to Red River, which discharges into the Mississippi) in northern part of Childress County.

SALT CREEK.—Guadalupe County; small intermittent stream flowing into Guadalupe River about 10 miles southeast of Seguin. San Marcos topographic map.

SALT CREEK.—Gillespie and Mason counties; a stream flowing through the south central part of Mason County and northwestern part of Gillespie County into James River (tributary to Llano River and thus to the Colorado); length, 18 miles. Kerrville and Mason topographic maps.

SALT CREEK.—Kent County; a stream flowing northeasterly 9 miles into Salt Fork of Brazos River (tributary to the Brazos) 5 miles northwest of Clairemont in western part of county.

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SALT CREEK.—McCulloch County; rises 16 miles northwest of Brady in the western part of the county; flows northward 18 miles through Salt Gap in in Brady Mountains into Colorado River 6 miles west of Waldrip in the northwestern part of the county. Eden topographic map.

SALT CREEK.—Montague County; rises at Montague in central part of county; flows northwesterly 18 miles into Red River (tributary to the Mississippi) about 1 mile northeast of Red River Station Crossing on northern county line. Montague topographic map.

SALT CREEK.—Motley County; rises in western part of county; flows northeastward 4 miles into Middle Pease River (tributary to Pease River and thus through Red River to the Mississippi) about 4 miles northwest of Matador.

SALT CREEK.—Motley County; rises in the southeastern part of county; flows northeasterly 10 miles into South Pease River (tributary through Middle Pease to Pease River and thus through Red River to the Mississippi) in the eastern part of county about one-half mile west of the county line.

SALT CREEK.—Stonewall and Kent counties; rises near Stonewall-Kent county line; flows northeasterly 8 miles into Croton Creek (tributary to the Brazos).

SALT CREEK.—Lampasas County; small stream flowing through the southwestern part of the county into Colorado River; length, 11 miles. Lampasas and San Saba topographic maps.

SALT CREEK.—Young County; rises near Olney in northern part of county; flows southeasterly 28 miles into Brazos River 8 miles south of Graham.

SALT FLAT CREEK.—Brazos County; rises in southeastern part of county; flows easterly 2½ miles into Navasota River (tributary to Brazos River).

SALT FORK.—Gonzales County; rises in the southwestern part of the county; flows southeasterly 17 miles into Fivemile Creek (tributary through Sandies Creek to Guadalupe River) near Pilgrim.

SALT FORK OF BRAZOS RIVER.—Stonewall, Kent, Garza, and Crosby counties; one of the principal tributaries of Brazos River; rises 10 miles south of Emma in southeastern part of Crosby County; flows southeasterly 175 miles to its confluence with Double Mountain Fork of Brazos River to form Brazos River in northeastern part of Stonewall County. (See Brazos River.)

SALT FORK OF RED RIVER.—Carson, Armstrong, Donley, and Collingsworth counties, Tex., rises near Conway in southern part of Carson County; flows southeasterly 90 miles to the Texas-Oklahoma State line, east of Wellington in southeastern part of Collingsworth County, thence southeasterly 65 miles through Oklahoma into Prairie Dog Town Fork of Red River (tributary to Red River and thus to the Mississippi) about 12 miles northwest of Doans in northern part of Wilbarger County, Tex.

SALTGRASS DRAW.—Brewster County; an intermittent stream 6 miles long rising 5 miles north of Terlingua and flowing into Terlingua Creek (tributary to Rio Grande) 6 miles northwest of Terlingua in southern part of county. Terlingua topographic map.

SALT HOLLOW.—Callahan County; small intermittent tributary flowing into Clear Branch (tributary to Pecan Bayou).

SALT PRONG OF HUBBARD CREEK.—Shackelford County; rises 10 miles southwest of Albany; flows northeasterly 20 miles into Hubbard Creek (tributary through Gonzales Creek to Clear Fork of Brazos River and thus to the Brazos) 9 miles east of Albany in eastern part of county. Albany topographic map.

Salt Prong Hubbard Creek, North Fork.—Shackelford County; rises 8 miles west of Albany; flows easterly 12 miles into Salt Prong of Hubbard Creek (tributary to Hubbard Creek and thus through Gonzales Creek and Clear Fork of Brazos River to the Brazos) 3 miles southeast of Albany. Albany topographic map.

San Ambrosio Creek.—Dimmit, Webb, and Maverick counties; rises near the line of Dimmit and Maverick counties; flows southwesterly about 20 miles through San Ambrosio Pass in southeastern part of Maverick County; thence southerly approximately 24 miles into Rio Grande in the extreme western corner of Webb County.

San Andres Creek.—Jim Wells County; small intermittent stream flowing southeasterly to its junction with Santa Gertrudis Creek (thence to Baffins Bay and Gulf of Mexico) near the center of the eastern county line.

San Antonio Creek.—Jim Hogg and Brooks counties; rises in the northeastern part of Jim Hogg County; flows eastward 10 miles through Jim Hogg County, then 18 miles through Brooks County into Laguna de Loma Blanca (thence to Gulf of Mexico through Palo Blanco Creek and Laguna Madre).

San Antonio Canyon.—Presidio County; rises in Chinati Mountains in the western part of the county, 12 miles northwest of Shafter; flows southwesterly into Rio Grande 8 miles northwest of Borracho; length, 11 miles; intermittent. Ruidoso and Shafter topographic maps.

San Antonio River.—Formed in Breckenridge Park, city of San Antonio, near the center of Bexar County by several large springs; flows southeasterly 25 miles through Bexar County, 39 miles through Wilson, 42 miles through Karnes, 44 miles through Goliad, then 8 miles along the boundary between Goliad and Victoria counties, thence 22 miles between Victoria and Refugio counties to its junction with Guadalupe River (thence to San Antonio Bay and Gulf of Mexico) about 12 miles above its mouth. The river, in its upper reaches, is extensively used for irrigation, power, and municipal purposes. Gaging stations at San Antonio and Calaveras. Area of drainage basin, 4,460 square miles; principal tributaries, Medina River and Cibolo Creek. San Antonio topographic map.

See Second Report of Texas Board of Water Engineers for list of certified filings for appropriation of water.

San Bernard River.—Rises near Austin-Colorado county line near New Ulm in the southwestern part of Austin County; flows southeasterly 105 miles. Along its course, the river forms the boundary between Austin and Colorado counties for 31 miles, Austin and Wharton for 8 miles, Fort Bend and Wharton for 28 miles; thence along the western part of Brazoria County 38 miles into Cedar Lake, an arm of the Gulf of Mexico.

San Cristobal Creek.—Karnes, Atascosa, and Live Oak counties; rises in the southwestern part of Karnes County; flows southwesterly 4 miles through Karnes County, then 17 miles through Live Oak County into Atascosa River (tributary to the Nueces through Frio River) at Fant City.

San Diego Creek.—Duval and Jim Wells counties; rises in northeastern part of Duval County; flows southeastward to its junction with Chiltipin Creek (thence to Gulf of Mexico through Pinias Creek, Santa Petronilla Creek, and Baffins Bay) in the northeastern part of Jim Wells County.

San Felipe Creek.—Val Verde County; rises about 8 miles northeast of Del Rio; flows southwesterly into Rio Grande 3 miles south of Del Rio.

San Fernando Creek.—Mason, Llano, and San Saba counties; rises northwest of Field Creek near the corner common to Mason, Llano, and San Saba counties; flows southeasterly 30 miles into Llano River (tributary to the Colorado) 5 miles west of Llano. Llano topographic map.

San Fernando Creek.—McMullen County; small intermittent stream; rises in the western part of the county; flows southeastward 16 miles to its junction with Nueces River. 6 miles southeast of Brushy Hills.

San Fernando Creek.—Jim Wells, Nueces, and Kleberg counties; rises in the eastern part of Jim Wells County; flows southeastward 2 miles through Jim Wells County, 2 miles through the southwestern part of Nueces County, along the boundary between Nueces and Kleberg counties for 7 miles, then 8 miles through the west central part of Kleberg County into Baffins Bay, an arm of Gulf of Mexico.

San Francisco Creek.—Brewster and Terrell counties; rises in northern part of Brewster County a few miles north of Haymond; flows southeastearly about 35 miles into Rio Grande near the point where Brewster-Terrell county line intersects Rio Grande. Hood Spring, Dove Mountain, Bullis Gap, and Indian Wells topographic maps.

San Gabriel River.—Milam and Williamson counties; formed at Georgetown by the union of the North and South Forks of San Gabriel River; flows northeasterly about 30 miles into Little River (tributary to Brazos River) 6 miles southwest of Cameron and west of Minerva. Georgetown and Taylor topographic maps.

San Gabriel River, North Fork of.—Burnet and Williamson counties; rises southwest of Lake Victor in northern part of Burnet County; flows southeasterly about 45 miles to Georgetown, where it unites with the South Fork to form San Gabriel River (tributary to Little River and thus to the Brazos) in western part of Williamson County. Burnet and Georgetown topographic maps.

San Gabriel River, South Fork.—Williamson and Burnet counties; rises 3 miles east of the town of Burnet in central part of Burnet County, at an approximate altitude of 1,500 feet above sea level; flows southeasterly 35 miles to its confluence with North Fork of San Gabriel River to form San Gabriel River (tributary to Little River and thus to the Brazos) at Georgetown in western part of Williamson County. Burnet and Georgetown topographic maps.

San Isabel Creek.—Webb County; rises about 35 miles northwest of the town of Laredo in northwestern part of county; flows southerly 35 miles into Rio Grande 15 miles northwest of Laredo.

San Jacinto River.—Harris County; formed in the northeastern corner of Harris County by the junction of the east and west branches (which rise in the southern part of Walker County and flow southeasterly through San Jacinto, Montgomery, and Liberty counties), takes a southeasterly course 39 miles through Harris County into San Jacinto Bay near Lynchburg, thence through Trinity Bay into Galveston Bay and Gulf of Mexico.

San Juanita Creek.—Webb and Zapata counties; an intermittent stream rising in the southern part of Webb County and flowing southwesterly 15 miles into Rio Grande in northwestern corner of Zapata County.

San Julian Creek.—Bandera County; small intermittent stream in eastern part of county; joins Medina River (tributary through San Antonio River to the Guadalupe) 5 miles east of Bandera.

San Lorenzo Creek.—Dimmit and Webb counties; rises in the southwestern part of Dimmit County; flows southerly 30 miles into Rio Grande in the northwestern corner of Webb County; intermittent.

San Marcos River.—Hays, Caldwell, Guadalupe, and Gonzales counties; formed near the northern limits of the city of San Marcos, Hays County, by several large springs, although its watershed extends about 10 miles northeast of the springs; flows southeasterly 4 miles through Hays County, then 2 miles forming the boundary between Hays and Caldwell counties, 32 miles along the boundary of Guadalupe and Caldwell counties, 4 miles between Gonzales and Caldwell counties ,thence 17 miles through Gonzales County to its confluence with Guadalupe River about 1½ miles southwest of Gonzales. Area of drainage basin, 1,380 square miles. Gaging stations at San Marcos and Ottine.

The stream is of economic importance; its waters are used for municipal purposes, power, and irrigation at various points. San Marcos and Flatonia topographic maps. (See Guadalupe River.)

San Miguel Creek.—Frio, Atascosa, and McMullen counties; formed in the east central part of Frio County-by junction of Black Creek and Rosales or Chacon Creek; flows southeastward 14 miles through Frio County, 11 miles through Atascosa County, and 21 miles through McMullen County into Frio River (tributary to Nueces River) about 12 miles east of Tilden.

San Patricio Creek.—McMullen County; small tributary to San Miguel Creek (thence to Nueces River through Frio River) rising in the northern part of the county; length, 8 miles.

San Pedro Creek.—Dimmit and Maverick counties; an intermittent stream about 2 miles long rising in the southwestern part of Dimmit County and flowing westward to its junction with San Ambrosio Creek (tributary to Rio Grande) about 2 miles south of San Ambrosio Pass.

San Pedro Creek.—Houston County; a stream 18 miles long flowing easterly into Neches River in northern part of county.

San Pedro Creek.—Bexar County; formed in San Pedro Park, San Antonio, by springs; flows southerly 2 miles through an artificial channel in the city of San Antonio into San Antonio River (tributary to Guadalupe River) one-half mile west of Conception Mission; gaging station at its intersection with Commerce Street, San Antonio. San Antonio topographic map.

San Pedro Creek.—Webb County; rises in the western port of county; flows southwesterly about 3 miles into Rio Grande; intermittent.

San Roque Creek.—Dimmit County; small stream in southeastern part of county; flows northeasterly 35 miles to its junction with Nueces River near eastern county line.

Sanches Creek.—Parker County; rises 1 mile northeast of Lambert in central part of county; flows southerly 17 miles into Brazos River 3 miles south of Balch in southern part of county. Weatherford topographic map.

Sancito or Escondido Creek.—Duval, Jim Wells. and Kleberg counties; rises near Sweden in the center of Duval County; flows southeastward and eastward 15 miles through Duval County, 11 miles through the southern part of Jim Wells County, then 10 miles through Kleberg County into Santa Gertrudis Creek (thence to Gulf of Mexico through Baffins Bay) southeast of Ricardo.

Sanders Creek.—Shelby County; small stream flowing into Stone Bayou (tributary to Sabine River) northwest of Hamilton in southeastern part of county.

S[illegible] H[illegible] Creek.—Dickens and Motley counties; rises in northern part of Dickens County; flows [illegible] miles into South Pease River (tributary to Middle Pease and thus through Pease and Red rivers to the Mississippi) about [illegible] miles north of northern boundary of Motley County in southeastern part of county.

Sanders Creek.—Freestone, Limestone, and Leon counties; rises near the town of Freestone in southern part of Freestone County; flows southerly 20 miles into Navasota River (tributary to Brazos River) southwest of Evansville in western part of Leon County.

Sanders Creek.—Lamar County; rises [illegible] miles north of High in western part of county; flows northeasterly [illegible] miles into Red River (tributary to the Mississippi) 3 miles west of Arthur City.

Sanderson Canyon.—Terrell County; rises in southwestern part; flows southerly about 14 miles into Rio Grande; intermittent. Dryden Crossing topographic map.

Sanders Creek.—Leon, Limestone, and Freestone counties; rises near the village of Freestone in southern part of Freestone County; flows southwesterly 11 miles into Navasota River (tributary to the Brazos) in northwestern corner of Leon County.

Sandies Creek, Elm Fork of.—Wilson, Karnes, and Gonzales counties; rises in the northeastern part of Wilson County; flows northeasterly 4 miles through Wilson, 4 miles through Karnes, thence 12 miles through Gonzales County to its confluence with Sandies Creek, northwest of Sample, and thus to Guadalupe River.

Sandies Creek.—Lavaca County; rises 5 miles southeast of Hallettsville; flows southeasterly 12 miles into Navidad River (which discharges into Lavaca River, thence to Matagorda Bay and Gulf of Mexico) near Seclusion.

Sandies Creek, Clear Fork.—De Witt County; rises in western part of county; flows northeasterly 14 miles into Sandies Creek (tributary to the Guadalupe) east of Westhoff.

Sandies Creek, Castlemans Fork.—Gonzales County; small stream flowing south and west of Yorktown in southern part of county into Sandies Creek, and thus to Guadalupe River.

Sandies Creek.—Gonzales and DeWitt counties; Castlemans or Main Fork rises in the western part of Gonzales County; flows southeasterly 31 miles through Gonzales County, then 15 miles through De Witt County, entering Guadalupe River 2 miles northwest of Cuero.

Sand Creek.—Atascosa County; a small tributary to Sesteadero Creek (thence to Nueces River through Atascosa and Frio rivers), rising in northwestern part of county and flowing southerly 8 miles.

Sand Creek.—Brown County; near Thrifty in the western part of county; flows six miles into Jim Ned Creek (tributary to Pecan Bayou and thus to the Colorado). Coleman topographic map.

Sand Creek.—Collingsworth County; a stream flowing northeasterly through southeastern part of county into Salt Fork of Red River (tributary through Prairie Dog Town Fork of the Red to Red River and thus to the Mississippi); length, 8 miles.

Sand Creek.—Collingsworth and Childress counties; rises in the southeastern part of Collingsworth County; flows southeastward 12 miles to its intersection of Texas-Oklahoma boundary line at the eastern line of Childress County about 4 miles south of the northeastern corner of county; thence southeasterly 12 miles through Harmon County, Oklahoma, into Prairie Dog Town Fork of Red River (tributary to Red River and thus to the Mississippi).

SAND CREEK.—Crosby County; rises 4 miles southeast of Crosbyton; flows southeasterly 11 miles into Davidson Creek (tributary to White River and thus through Salt Fork of Brazos River to the Brazos) near Holt's store in southeast part of county.

SAND CREEK.—Garza County; rises 3 miles southeast of Post City; flows easterly 11 miles into North Fork of Double Mountain Fork of Brazos River (tributary through Double Mountain Fork of the Brazos to the Brazos).

SAND CREEK.—Grayson County; rises 5 miles northwest of Sherman in central part of county; flows southeasterly 5 miles into Postoak Creek (tributary to Choctaw Creek, thence to Red River, and thus to the Mississippi) in southern edge of Sherman city limits. Denison topographic map.

SAND CREEK.—Grimes County; an intermittent stream flowing to a point southeast of the town of Navasota where it enters Walker Creek and thus to Brazos River; length, 7 miles. Navasota topographic map.

SAND CREEK.—Mason and Llano counties; small intermittent stream 5 miles long flowing along the boundary of Mason and Llano counties north of Castell; empties into Elm Creek and thus through the Llano to Colorado River. Llano topographic map.

SAND CREEK.—Wheeler and Collingsworth counties; rises in southwestern part of Wheeler County; flows southerly 12 miles into Salt Fork of Red River (tributary to Prairie Dog Town Fork of the Red and thus through Red River to the Mississippi) in the western part of Collingsworth County.

SAND CREEK.—Zavalla County; small intermittent stream in northern part of county; flows southward 10 miles to its junction with Nueces River 5 miles south of La Pryor. Uvalde topographic map.

SAND SPRING CREEK.—Llano County; a small intermittent stream 4 miles in length flowing into Johnson Creek which connects with Llano River (tributary to the Colorado) southeast of Valley Springs in the northern part of the county. Llano topographic map.

SANDY CREEK.—Austin County; rises 6 miles east of New Ulm in central part of county; flows easterly 7 miles into Mill Creek (tributary to Brazos River) 3 miles southwest of Bellville.

SANDY CREEK.—Bastrop County; small stream 13 miles in length in the central part of the county; joins Walnut Creek (tributary to Colorado River) 2 miles southwest of Hills Prairie. Flatonia and Bastrop topographic map.

SANDY CREEK.—Brazos County; an easterly flowing stream 8 miles long joining Navasota River (tributary to Brazos River) opposite Madison-Grimes county line.

SANDY CREEK.—Colorado, Wharton, and Jackson counties; rises in the southwestern part of Colorado County; flows southeasterly and southerly 16 miles along the southwestern boundary of Colorado County, 12 miles through the western part of Wharton County, then 14 miles through Jackson County into Navidad River (thence to Lavaca River, Matagorda Bay and Gulf of Mexico) southwest of Ganado.

SANDY CREEK.—Cooke and Grayson counties; rises about 3 miles north of Callisburg in the eastern part of Cooke County; flows easterly 14 miles into Mineral Creek (tributary to Red River and thus to the Mississippi) about 3 miles north of Steedman in the northwestern part of Grayson County. Denison topographic map.

SANDY CREEK.—Fannin County; rises in northeastern part of county; flows northerly 5½ miles into Bois d'arc Creek (tributary to Red River and thus to the Mississippi).

Sandy Creek.—Fisher County; an intermittent stream rising 5 miles south of Roby; thence flows northeasterly to a point 4 miles east of Roby in central part of county, where it enters Clear Fork of Brazos River and thus to the Brazos [illegible] miles. Roby topographic map.

Sandy Creek.—[illegible] County; rises in southwestern part of county; flows [illegible] into Double Mountain Fork of Brazos River and thus to the Brazos.

Sandy Creek.—[illegible] County; small intermittent stream flowing into [illegible] Creek (tributary to Red River and thus to the Mississippi) near [illegible] in [illegible]western part of county. Denison topographic map.

Sandy Creek.—Jasper County; rises about 7 miles north of the town of Jasper; flows southerly 8 miles, then southwesterly 16 miles into Neches River.

Sandy or [illegible] Creek.—Lavaca County; rises in southeastern part of county; flows southerly into Navidad River (tributary to Lavaca River, [illegible] Bay and Gulf of Mexico) near Sedusion; length, 7 miles.

Sandy Creek.—Llano and Gillespie counties; rises 10 miles north of the town of Fredericksburg in northern part of Gillespie County; flows northward and eastward about 35 miles into Colorado River 6 miles south of Kingsland in the eastern part of Llano County. Llano and Burnet topographic maps.

Sandy Creek.—Lipscomb County; rises [illegible] miles southwest of Lipscomb; flows northeasterly into Wolf Creek (tributary through North Fork of Canadian River to the Canadian and thus through Arkansas River to the Mississippi) 1 mile west of Lipscomb in central part of county; intermittent.

Sandy Creek.—Montgomery County; small tributary to Lake Creek (tributary to West San Jacinto River, San Jacinto River and thus to Gulf of Mexico) in the western part of Montgomery County; flows northeastward 5 miles.

Sandy Creek.—Milam County; a stream 12 miles long flowing into Little River (tributary to the Brazos) between Rockdale and Cameron in central part of county.

Sandy Creek.—Newton and Sabine counties; rises in the northwestern corner of Newton County; flows northeasterly 14 miles into Sixmile Creek (tributary to Sabine River) in the southeastern part of Sabine County.

Sandy Creek.—Robertson County; rises near Calvert; flows southerly 5 miles into Mud[illegible] Creek (tributary to Little Brazos River and thus to the Brazos) 4 miles north of Hearne.

Sandy Creek.—Sabine and Newton counties; rises in southern part of Sabine County; flows southwesterly 5 miles into Big Cow Creek (tributary to Sabine River).

Sandy Creek.—Sabine and San Augustine counties; rises in southwestern part of Sabine County; flows southwesterly 11 miles into Ayish Bayou (tributary to Angelina River and thus to the Neches) in the southeastern part of San Augustine County.

Sandy Creek.—Sabine County; small stream flowing into Devils Ford Creek (tributary through Bear Creek to Ayish Bayou, then to Angelina River, and thus to the Neches) in southwestern part of county.

Sandy Creek.—Stephens and Eastland counties; rises 7 miles southwest of Cisco; flows northerly 45 miles into Hubbard Creek (which discharges into Gonzales Creek and thus through Clear Fork of Brazos River to the Brazos) 6 miles northwest of Breckenridge in northwestern part of Stephens County. Albany, Eastland, and Breckenridge topographic maps.

Sandy Creek.—Stephens County; rises $2\frac{1}{2}$ miles northwest of Caddo in eastern part of county; flows northerly 9 miles into Big Cedar Creek, thence into Brazos River. Breckenridge topographic map.

SANDY CREEK.—Travis County; rises 3 miles south of Hopewell in the northwestern part of the county; flows southeastward 15 miles into Colorado River, 1 mile southeast of Valente. Georgetown and Austin topographic maps.

SANDY CREEK.—Washington County; rises 5 miles northwest of Brenham; flows easterly 7 miles into New Years Creek (tributary to Brazos River) 2½ miles north of Brenham in central part of county.

SANDY CREEK.—Wise County; small tributary to Big Sandy Creek (which discharges into Trinity River through the West Fork of the Trinity) northwest of Decatur in central part of county.

SANS CREEK.—La Salle County; tributary to Nueces River in the southeastern part of county; flows southward about 40 miles.

SAN SABA RIVER.—Schleicher, Menard, Mason, McCulloch, and San Saba counties; formed near Fort McKavett and the Schleicher-Menard county line by a number of large springs. The North and Middle Valley branches (intermittent) rise west of Fort McKavett in the southeastern part of Schleicher County; the main stream flows easterly 38 miles through Menard County, 7 miles through the northwestern corner of Mason County, 20 miles through the southeastern part of McCulloch County, then 35 miles through San Saba County into Colorado River 8½ miles northeast of San Saba in the eastern part of San Saba County. Area of drainage basin, 3,150 square miles. Gaging stations at Menard and near San Saba.

In the vicinity of Menard and San Saba lands are irrigated, but between these two points the use of water is greatly diminished. Water is stored in Brady Creek, principal tributary to San Saba River, by the city of Brady for municipal use, and a small amount of power is developed by use of the water at San Saba. At 12 miles below Menard, the river enters a portion of the drainage basin classed as rough but interspersed with small irrigable valleys. It traverses this character of topography for 50 miles until it reaches a point 17 miles above the town of San Saba, where it widens into a rich valley. Fort McKavett, Mason, Brady, and San Saba topographic maps.

See Second Report of Texas Board of Water Engineers for list of certified filings of appropriations for use of water.

SANTA ANNA BRANCH.—Coleman County; southwest of the town of Santa Anna in the central part of the county; empties into Home Creek and thus to the Colorado River; length, 9 miles. Coleman topographic map.

SANTA GERTRUDIS CREEK.—Duval, Jim Wells, and Kleberg counties; rises in the west central part of Duval County; flows southeastward 30 miles through Duval and Jim Wells counties, then 27 miles through Kleberg County into Baffins Bay, an arm of the Gulf of Mexico.

SANTA PETRONILLA CREEK.—Duval, Jim Wells, Nueces, and Kleberg counties; rises near Shaeffer in the northeastern part of Duval County; flows southeasterly 10 miles through Duval County, 20 miles through the north central part of Jim Wells County, 24 miles through the southwestern part of Nueces County, then 12 miles through the eastern part of Kleberg County, into Baffins Bay, an arm of the Gulf of Mexico.

SANTO TOMAS CREEK.—Webb County; an intermittent stream in southwestern part of county; flows southerly 8 miles into Rio Grande.

SANZ CREEK.—Bexar County; rises in the western part of the county; flows into the Medina River (tributary to San Antonio River and thus to the Guadalupe) 4 miles northeast of Castroville; intermittent.

SAUCILLO CREEK.—Webb County; an intermittent stream; rises in the western part of the county; flows southward 2 miles into Rio Grande.

SAUCITA CREEK.—Presidio County; an intermittent stream in northern part of county; flows easterly 16 miles into Long Draw, thence to Alamita Creek (tributary to Rio Grande) 1 mile west of Bogel. Marfa topographic map.

SAUS OR IMPERIALIST CREEK.—Kinney and Maverick counties; rises near Spofford in Kinney County; flows southerly 8 miles through Kinney County, then continues the same course 25 miles through Maverick County to its junction with Rio Grande, approximately 2 miles north of Eagle Pass; intermittent. Brackett topographic map.

SAUZ OLMOS CREEK.—Starr and Zapata counties; rises in the northeast corner of Zapata County; flows southerly 75 miles into Rio Grande 3 miles southeast of Rio Grande City in the southern part of Starr County.

SAWYER BRANCH.—Erath County; rises south of Dublin in southern part of county; flows southerly 3 miles into Resley Creek (tributary to the Leon and thus through Little River to the Brazos); intermittent. Stephenville topographic map.

SAWLOG CREEK.—Guadalupe County; rises near Capote School, in southeastern part of county; tributary to Guadalupe River; intermittent. San Marcos topographic map.

SAWMILL CANYON.—Brewster County; rises in western part of county, 2½ miles northwest of Sawmill Mountain; flows southeasterly 4½ miles into Terlingua Creek (tributary to Rio Grande); intermittent. Terlingua topographic map.

SCARBOROUGHS CREEK.—Lavaca County; rises in southwestern part of county; flows southeasterly 5 miles between Big Brushy and Clarks Creek into Clarks Creek (tributary to Lavaca River, Matagorda Bay, and Gulf of Mexico).

SCHEP CREEK.—Mason County; a stream flowing through central part of the county into the Llano (tributary to Colorado River); length, 10 miles. Mason topographic map.

SCHILLA BAYOU.—Harris County; a small tidal bayou in the southeastern part of the county; flows northeasterly about 1 mile into Ship Channel (Buffalo Bayou) near Penn City, thence to Galveston Bay and Gulf of Mexico.

SCHOOL CREEK.—Lampasas County; rises east of Lometa; flows easterly 16 miles into Lampasas River (tributary through Little River to the Brazos). Lampasas topographic map.

SCHOOL CREEK.—Young and Jack counties; rises in the northeastern part of Young County; flows northeasterly 10 miles into West Fork of Trinity River (tributary to Trinity River), in northwestern part of Jack County.

SCOOLER CREEK.—Rusk County; rises about 6 miles southwest of Henderson; flows southeasterly 9 miles into Big Shawnee Creek and thus through Angelina River to the Neches.

SCOTT BAYOU.—Cass and Marion counties; rises about 5 miles northwest of Lodi (Marion County), in southern part of Cass County; flows southerly 8 miles into Black Cypress Bayou (tributary to Caddo Lake through Big Cypress Bayou and thus through Red River to the Mississippi) about 3 miles north of Jefferson, in central part of Marion County.

SCOTT BRANCH.—Gillespie County; flows northeastward 7 miles into Pedernales River (tributary to Colorado River) 7 miles southwest of Harper, in the southwestern part of the county. Kerrville topographic map.

SCOTT CREEK.—Cooke County; rises about 4 miles southwest of Gainesville; flows southeasterly 10 miles into Elm Fork of Trinity River (tributary to Trinity River) about 4 miles west of Burns. Gainesville topographic map.

SCOTTS CREEK.—Marion County; rises near Cass-Marion county line 4 miles west of Lodi; flows southerly 7 miles into Black Cypress Bayou (tributary to Ferry and Caddo lakes through Big Cypress Bayou, thence through Red River to the Mississippi) 2½ miles north of Jefferson, in central part of county.

SCOTT CREEK.—Stephens and Young counties; a stream flowing northeasterly 3 miles into Brazos River 1 mile north of Young-Stephens county line.

SCRUGGAN BRANCH.—Tarrant County; small stream flowing into West Fork of Trinity River (tributary to the Trinity) about 5 miles west of Fort Worth. Fort Worth topographic map.

SCRUGGS CREEK.—Caldwell County; small stream in southeastern part of county; flows into Sandy Fork of Peach Creek, and thus through Peach Creek to Guadalupe River; intermittent. Flatonia topographic map.

SEALS CREEK.—Caldwell County; rises near McCutcheon School in the southern part of the county; flows southeasterly 9 miles into San Marcos River (tributary to the Guadalupe) 2 miles southwest of Luling. San Marcos topographic map.

SEALS GULLY.—Harris County; rises in northwestern part of county 2½ miles southeast of Willow Siding; flows southeasterly 5 miles into Cypress Creek; intermittent. Louetta and Spring topographic maps.

SECO CREEK.—Medina and Frio counties; rises in the northwestern corner of Medina County; flows southeastward 40 miles into Hondo Creek (tributary to Nueces River through the Frio) 5 miles southwest of Yancey.

SECOND ELM CREEK.—La Salle County; small intermittent stream in western part of county; flows southeasterly about 20 miles to its junction with Las Raices Creek (tributary to Nueces River).

SECOND OR MIDDLE YEGUA CREEK.—Lee and Williamson counties; rises in southeastern corner of Williamson County; flows southeasterly 30 miles to its confluence with First Yegua Creek to form Yegua Creek (tributary to Brazos River) about 5 miles southeast of Dime Box in southeastern part of Lee County. Bastrop topographic map.

SECOND CREEK.—Lipscomb County; rises 3 miles southwest of Kiowa; flows southerly 10 miles into Wolf Creek (tributary through North Fork of Canadian River to the Canadian and thus through Arkansas River to the Mississippi) 6 miles northwest of Valley Park in western part of county.

SEMINOLE CANYON.—Terrell County; rises in southwestern part; flows easterly about 7 miles into Sanderson Canyon (tributary to Rio Grande); intermittent. Indian Wells and Dryden Crossing topographic maps.

SENECA BURRO CREEK.—Dallam County; an intermittent stream rising in southern part of Cimarron County, Okla., and flowing southerly to its junction with Rabbit Ear Creek (tributary to Coldwater Creek, and thus through Beaver, North Fork of Canadian, and Arkansas rivers to the Mississippi) in northern part of Dallam County, Tex.

SESTEADERO CREEK.—Atascosa County; rises in the northwestern part of the county; flows southeasterly 8 miles into Atascosa River (tributary to Nueces River through the Frio).

SENGER GULLY.—Harris County; rises in northwestern part of county 2½ miles southwest of Spring; flows southeasterly 3 miles into Cypress Creek; intermittent. Spring topographic map.

SETTLERS CREEK.—Childress County; a stream 7 miles long flowing southeasterly 7 miles through northeastern part of county into Spiller Creek (tributary through Prairie Dog Town Fork of Red River to Red River and thus to the Mississippi).

SHAFTERS LAKE.—Andrews County; west of Logsdon in northwestern part of county; outlet, North Concho River (tributary through Concho River to the Colorado); small.

SHAFTER CANYON.—Terrell County; rises in southwestern part near Loma Vista; flows southerly 6 miles into Rio Grande; intermittent. Dryden Crossing topographic map.

SHANNON CREEK.—Grayson County; rises 4 miles northeast of Sherman; flows easterly 6 miles into Choctaw Creek (tributary to Red River, which discharges into the Mississippi).

SHAWNEE CREEK.—Angelina County; rises in the central part of county about 5 miles southeast of Homer; flows southeasterly 17 miles into Neches River about 5 miles southwest of Dunkin.

SHAWNEE CREEK.—Grayson County; rises about 3 miles east of Pottsboro in northern part of county; flows intermittently northeasterly 6 miles into Red River (tributary to Mississippi River) about a mile west of Missouri, Kansas & Texas Railway bridge north of Denison. Denison topographic map.

SHAWNEE CREEK.—Rusk County; rises in central part of county 4 miles northeast of Henderson; flows southwesterly 28 miles into Angelina River (tributary to Neches River, thence through Sabine Lake to Gulf of Mexico).

SHAWNEE CREEK.—Red River County; rises about 6 miles southwest of Avery in southeastern part of county; flows southerly 13 miles into Sulphur River which discharges into the Mississippi through Red River.

SHAWS CREEK.—Mills County; a small stream 6 miles southeast of Big Valley in the southern part of county; flows 4 miles into Colorado River. San Saba topographic map.

SHEEP RANCH HOLLOW.—Eastland County; a stream flowing northeasterly 6 miles into Elm Creek (tributary to Sabanna River and thus through Leon and Little rivers to the Brazos) 7 miles south of Carbon in southern part of county. Eastland topographic map.

SHEPHERDS CREEK.—Madison County; rises in western part of county; flows southwesterly 10 miles into Navasota River (tributary to the Brazos) southwest of Zulch.

SHINOAK BRANCH.—Comanche and Eastland counties; rises near Gorman in southeastern part of Eastland County; flows southerly 5 miles into Sabanna River (tributary through Leon River to Little River and thus to the Brazos) 9 miles northwest of De Leon in northern part of Comanche County. Eastland topographic map.

SHIBLEY BRANCH.—Shackelford and Throckmorton counties; a southerly flowing stream joining Clear Fork of Brazos River (tributary to the Brazos) 3 miles east of Fort Griffin in northeastern part of Shackelford County; length, 5 miles. Albany topographic map.

SHOAL OR JACKSON CREEK.—Cass County; rises about 2 miles southeast of Douglasville; flows northeasterly 6½ miles into Sulphur River (tributary to Red River and thus to the Mississippi). Linden and New Boston topographic maps.

SHOAL CREEK.—Coryell County; an intermittent stream flowing northeasterly 6 miles into Leon River (tributary to Little River and thus to the Brazos) near Twin Mountains in central part of county. Gatesville topographic map.

SHOAL CREEK.—Travis County; rises 2 miles south of Duval in the central part of the county; flows southerly 9 miles into Colorado River in the western part of the City of Austin. Austin topographic map.

SHORT CANYON.—Jeff Davis County; a stream 8 miles long rising 7 miles northwest of Fort Davis in Davis Mountains and flowing northeasterly to its junction with Limpia Creek (tributary through Paisano Creek to Pecos River and thus to Rio Grande) 13 miles northeast of Fort Davis. Fort Davis topographic map.

SHORT CREEK.—Wichita County; rises 9 miles east of Electra in northern part of county; flows southerly into Lost Creek (tributary through North Fork of Buffalo Creek to Buffalo Creek, thence through Wichita River to Red River and thus to the Mississippi); intermittent. Barwise School topographic map.

SHORT CREEK.—Hunt County; rises about 2 miles north of Wolfe City in northern part of the county near northern boundary of county; flows southerly 4 miles into South Sulphur River (tributary to Sulphur River and thus to the Mississippi through Red River).

SHORES CREEK.—Childress and Cottle counties; rises about 9 miles southwest of the town of Childress in southwestern part of Childress County; flows southeasterly 13 miles into Pease River (tributary to Red River and thus to the Mississippi) in northern part of Cottle County.

SIBLEYS CREEK.—Throckmorton County; a stream flowing southwesterly 1½ miles into Clear Fork of Brazos River (tributary to Brazos River) north of Fort Griffin in southern part of county.

SIERRITA DE LA CRUZ CREEK.—Potter and Oldham counties; rises in southeastern part of Oldham County; flows northeasterly 20 miles into Canadian River (tributary to Arkansas River and thus to the Mississippi) 2 miles southeast of Amy.

SILVER CREEK.—Borden County; small stream in the eastern part of county flowing southerly 8 miles to its junction with North Fork of Colorado River (tributary to the Colorado) north of Durham.

SILVER CREEK.—Llano County; flows into Sandy Creek (tributary to Colorado River) near Potato Hill in southern part of county; length, 4 miles. Llano topographic map.

SILVER CREEK.—Freestone County; small stream flowing into Alligator Creek (tributary through Buffalo and Upper Keechi creeks to Trinity River) in southwestern part of county.

SILVER CREEK.—Mitchell County; small tributary to Colorado River north of Silver in the southeastern part of the county; length, 3½ miles.

SILVER CREEK.—Parker and Tarrant counties; rises about 2 miles southwest of Veal Station in Parker County; flows southeasterly into West Fork of Trinity River (tributary to Trinity River) 9 miles northwest of Fort Worth in western part of Tarrant County; length, 16 miles. Weatherford and Fort Worth topographic maps.

SILVER LAKE.—Harris County; 7½ miles southeast of Humble; outlet, San Jacinto River which discharges into Gulf of Mexico; one-half mile long and one-twentieth mile wide. Harmaston topographic map.

SILVER LAKE.—Kinney County; in northern part of county; near Swanters ranch; outlet, West Nueces River; no inlet shown on map; length, 2 miles. Nueces topographic map.

SILVERMINE CREEK.—Llano County; an intermittent stream flowing through the southern part of the county into Sandy Creek and thus to the Colorado; length, 3 miles. Llano topographic map.

SIMS BAYOU.—Harris County; rises in the southern part of the county; flows northeasterly 13 miles into Ship Channel (Buffalo Bayou) (and thus to Galveston Bay and Gulf of Mexico) near Clinton; tidal 4 miles in its lower course. Almeda, Bellaire, and Park Place topographic maps.

[illegible]—[illegible] County; rises [illegible] north of [illegible]; flows southerly 8 miles into [illegible] River (tributary to Brazos River) 4 miles northeast of [illegible] topographic map.

[illegible]—[illegible] rises 7 miles [illegible] of [illegible] in [illegible] part of [illegible] County; flows southeastward 25 miles into Lampasas River (tributary to Little River and thus to the Brazos) 2 miles southeast of [illegible] in [illegible] part of Lampasas County. [illegible] topographic map.

[illegible]—[illegible] County; rises in [illegible] part of county, an intermittent stream [illegible] and thus to Guadalupe River.

[illegible]—[illegible] County; a stream flowing southeast of San Saba in the [illegible] part of the county; [illegible] into the San Saba (tributary to Colorado River) [illegible] miles. San Saba topographic map.

[illegible]—[illegible] County; rises about 7 miles southeast of Shelbyville, in southeastern part of county; flows easterly 23 miles into Sabine River about 3 miles north of Hamilton.

[illegible], North Fork—[illegible] County; flows into Sip Bayou (tributary to Sabine River) north of [illegible], in southeastern part of county.

[illegible] Branch—[illegible] County; a northerly flowing stream, 4 miles long uniting with [illegible] Creek (tributary to Leon River and thus through Little River to the Brazos) [illegible] miles southeast of Sipe Springs, in western part of county; passes through Sipe Springs. Eastland topographic map.

[illegible] Creek—[illegible] rises in northwestern part of Motley County; flows northeasterly [illegible] miles to a point about 1 mile east of the northwestern corner of [illegible] County, where it enters Pease River (tributary to Red River and thus to the Mississippi).

[illegible] Creek—[illegible] rises at Howe, in Grayson County; flows southeasterly and southerly 35 miles into East Fork of Trinity (tributary to Trinity River) 2 miles west of Lavon, in Collin County. [illegible] topographic map.

[illegible] Bayou.—Panola County; rises about 3 miles southwest of Carthage; flows easterly 13 miles into Sabine River about 3 miles south of Pulaski.

Sixmile Branch.—Caldwell County; near [illegible]; small intermittent stream flowing into Plum Creek and thus through San Marcos River to the Guadalupe. San Marcos topographic map.

Sixmile Creek.—Bexar County; small intermittent stream flowing into San Antonio River 4 miles south of San Antonio and thus to the Guadalupe. San Antonio topographic map.

Sixmile Creek.—Llano County; rises 2 miles northwest of Oxford, in southern part of county; flows northward 10 miles into Llano River (tributary to the Colorado) 6 miles west of the town of Llano. Llano topographic map.

Sixmile Creek.—Sabine County; rises about 4 miles north of the corner of Newton and Jasper counties, in the southern part of the county; flows easterly 18 miles into Sabine River near Fairdale.

Sixmile Creek.—Young County; a stream flowing northerly 6 miles into Brazos River 2 miles west of New Castle, in western part of county.

Six Shooter Creek.—Stephens County; a small intermittent stream flowing southeastward 3 miles into Hubbard Creek (tributary to Gonzales Creek, thence through Clear Fork of Brazos River to the Brazos) southwest of Crystal Falls, in northern part of county. Breckenridge topographic map.

Sixteenmile Creek.—Fort Bend and Austin counties; a stream 6 miles long flowing northeasterly along the Fort Bend-Austin county line into Brazos River.

SKILLET CREEK.—Donley County; a stream 6½ miles long flowing southerly through northeastern part of county to Whitefish Creek, thence to Salt Fork of Red River and thus through Prairie Dog Town Fork of the Red and Red rivers to the Mississippi.

SKINOUT CREEK.—Jones County; an intermittent stream rising near Skinout Mountain and flowing northeasterly 10 miles into California Creek (tributary through Clear Fork of Brazos River to the Brazos) northwest of Anson, in western part of county. Roby topographic map.

SKUNK ARROYO.—Oldham County; rises 18 miles west of Cheyenne; flows northerly into Canadian River (which discharges into the Mississippi through Arkansas River) 10 miles west of Cheyenne, in northern part of county; length, 10 miles; intermittent.

SKUNK CREEK.—Lipscomb County; an intermittent stream rising 10 miles north of Lipscomb and flowing southeasterly to its junction with Wolf Creek (tributary through North Fork of Canadian River to the Canadian and thus through Arkansas River to the Mississippi) 6 miles east of Lipscomb, in eastern part of county.

SLAPHAM CREEK.—Red River County; rises about 4 miles southeast of Clarksville; flows southerly 4 miles into Guest Creek (tributary through Cuthand Creek to Sulphur River and thus through Red River to the Mississippi).

SLAUGHTER CREEK.—Travis County; an intermittent stream in the southern part of the county; rises near Cedar Valley; flows southeastward 13 miles into Onion Creek (tributary to Colorado River) 1 mile west of Bluff Springs. Austin topographic map.

SLICKROCK CREEK.—Blanco and Llano counties; rises 5 miles west of Round Mountain, in northern part of Blanco County; flows northerly 10 miles to its junction with Colorado River 4½ miles west of the town of Marble Falls, near the Llano-Burnet county line. Blanco and Burnet topographic maps.

SLOAN CREEK.—Fannin County; rises about 5½ miles southeast of Bonham in central part of county; flows northerly 8 miles into Bois d'Arc Creek (tributary to Red River and thus to the Mississippi) 4 miles northeast of Bonham.

SLOUGH BRANCH.—Shelby County; short stream flowing into Tancha Bayou (tributary to Sabine River) northeast of Center in northeastern part of county.

SLOUGH CREEK.—Franklin County; small stream in northern part of county flowing southeasterly 3 miles into Whiteoak Bayou (tributary to Sulphur River, thence through Red River to the Mississippi).

SLOUGH CREEK.—Lamar County; rises in northwestern part of county; flows northerly 7 miles into Red River (tributary to the Mississippi) near Direct, near northwestern corner of county.

SMEATHERS CREEK.—Lavaca County; rises about 3 miles east of Hankhaus; flows southeasterly 11 miles into Rocky Creek (tributary to Lavaca River, Matagorda Bay and Gulf of Mexico) 4 miles southwest of Hallettsville.

SMITH CREEK.—Ellis County; small stream flowing into Trinity River in the eastern part of the county.

SMITH CREEK.—Franklin County; small stream 4 miles long in southwestern part of county flowing southeasterly to Big Cypress Creek, thence to Caddo Lake, and thus through Red River to the Mississippi.

SMITH CREEK.—Grimes County; small stream flowing westward and southwestward 10 miles into Ben Fort Creek (tributary through Navosota River to Brazos River) in north central part of county.

SMITH CREEK.—Gonzales County; small intermittent stream northwest of Gonzales near center of county; flows southerly 9 miles into San Marcos River (tributary to the Guadalupe). Flatonia topographic map.

SMITH CREEK.—Guadalupe County; small intermittent stream southwest of the town of Luling in the northeastern part of the county; flows into San Marcos River (tributary to the Guadalupe). San Marcos topographic map.

SMITH CREEK, NORTH FORK OF.—Gonzales County; rises northwest of the town of Gonzales; flows into Smith Creek (and thus to San Marcos River tributary to the Guadalupe); intermittent. Flatonia topographic map.

SMITH CREEK, DRY FORK OF.—Gonzales County; northwest of Gonzales; unites with Smith Creek, and thus to San Marcos River (tributary to Guadalupe River); intermittent. Flatonia topographic map.

SMOKY CREEK.—Brewster County; formed 12 miles north of Reed Camp in Chisos Mountains by springs unnamed on map; flows southwesterly into Rio Grande 7 miles west of Reed Camp; intermittent. Chisos Mountains topographic map.

SMUGGLERS BAYOU.—Calhoun County; a tidal stream in western part of the county at the mouth of Guadalupe River; flows into Mission Lake and thus through Guadalupe Bayou to San Antonio Bay and thence to Gulf of Mexico.

SNAILUM CREEK.—Shackelford County; rises 2 miles north of Albany; flows easterly 8 miles into Salt prong of Hubbard Creek (tributary through Hubbard to Gonzales Creek, thence through Clear Fork of Brazos River to the Brazos) 7 miles east of Albany. Albany topographic map.

SNAKE CREEK.—Fort Bend County; rises in the western part of the county; flows southerly 11 miles into San Bernard River and thus to Gulf of Mexico.

SNAKE CREEK.—Jack County; joins Carrolls Creek (tributary to West Fork of Trinity River and thus to the Trinity) southeast of the town of Jacksboro in the southern part of this county.

SNAKE CREEK.—McLennan County; an intermittent stream rising near Hill-McLennan County line and flowing southwesterly 4 miles into Aquilla Creek (which discharges into Brazos River) 3 miles southeast of Tyson in northern part of county. Waco topographic map.

SNAKE CREEK.—Tom Green County; a stream 16 miles long flowing through the eastern part of the county to its junction with Lipan Creek (tributary to Concho River and thus to the Colorado.) San Angelo topographic map.

SOAP CREEK.—Ellis County; a northerly flowing stream joining Mountain Creek (tributary to West Fork of Trinity River, thence to the Trinity) in northwestern part of county; length, 7 miles. Cleburne and Fort Worth topographic maps.

SOCAGEE BAYOU.—Panola County; rises about 4 miles northeast of DeBerry; flows southerly 25 miles into Sabine River about 5 miles southwest of Logan.

SOL CREEK.—Mason County; a stream 7 miles long southwest of Fredonia in the northeastern part of the county; empties into Loafer Creek (tributary to Tiger Creek and thus through San Saba River to the Colorado). Mason topographic map.

SORREL CREEK.—Comal County; rises near Cranes Mill in northeastern part of county; empties into Potter Creek, thence to Guadalupe River; intermittent.

SOUTH BEAVER CREEK.—Foard and Wilbarger counties; rises in southeastern part of Foard County; flows easterly 18 miles into Beaver Creek (tributary to Wichita River and thus through Red River to the Mississippi) in southwestern part of Wilbarger County.

SOUTH BEAR CREEK.—Parker County; rises at Parsons in the southeastern part of county; flows southeasterly 8 miles into Bear Creek (tributary to Clear Fork of Trinity River, and thus to the Trinity through West Fork of Trinity River) about 2 miles north of Virgile. Weatherford topographic map.

SOUTH BIDAIS CREEK.—Grimes and Walker counties; rises near Bedias in the northeastern part of Grimes County; flows northeasterly 10 miles through Grimes, then 13 miles through Walker County into Bidais Creek (tributary to Trinity River) northeast of Sion.

SOUTH BINGHAM CREEK.—Montague County; an intermittent stream joining Bingham Branch (which discharges into Clear Creek, thence to Elm Fork of Trinity River and the Trinity) southeast of Forestburg. Montague topographic map.

SOUTH BRADY CREEK.—Menard, Concho, and McCulloch counties; rises 10 miles south of Eden, in the northeastern part of Menard County; flows northeastward 21 miles through the corner of Concho County into Brady Creek (tributary to Colorado River through the San Saba) 10 miles west of Brady, in the western part of McCulloch County. Eden topographic map.

SOUTH COW BAYOU.—McLennan and Falls counties; rises 3 miles north of Moody, in southern part of McLennan County; flows southeasterly 16 miles to its junction with the North Cow Bayou to form Cow Bayou (tributary to the Brazos) 1 mile north of Mooresville, in western part of Falls County. Temple topographic map.

SOUTH COPPERAS CREEK.—Comanche County; rises northeast of May, near Brown-Comanche county line; flows northeasterly 11 miles into Copperas Creek (tributary through Leon and Little rivers to the Brazos) 4 miles southeast of Sipe Springs, in western part of county. Brownwood and Eastland topographic maps.

SOUTH COTTONWOOD CREEK.—Armstrong County; southeastern part; a headwater stream of Cottonwood Creek (tributary to Mulberry Creek and thus through Prairie Dog Town Fork of Red River and Red River to the Mississippi); length, 5 miles.

SOUTH CORRAL CREEK.—Collingsworth County; rises in northeastern part of county and flows northeastward 2 miles to North Corral Creek (tributary to Elm Fork of Red River and thus through North Fork of Red River to the Red and thus to the Mississippi).

SOUTH FISH CREEK.—Cooke County; rises about 3½ miles west of Marysville, in northern part of county; flows easterly 11 miles to its junction with North Fish Creek to form Fish Creek (tributary to Red River and thus to the Mississippi) about 6½ miles east of Marysville. Gainesville topographic map.

SOUTH GRAPE CREEK.—Gillespie County; joint Pedernales River (tributary to the Colorado 2 miles southwest of Stonewall, in the southern part of the county; length, 11 miles. Fredericksburg topographic map.

SOUTH JIM NED CREEK.—Coleman County; small stream flowing into Jim Ned Creek (tributary to Pecan Bayou and thus to the Colorado) in northwestern part of county, southeast and northeast of Atoka; length, 13 miles. Abilene and Ballinger topographic maps.

SOUTH LEON CREEK.—Comanche County; rises in southwestern corner of county at an approximate altitude of 1,600 feet above sea level; flows northeasterly 25 miles, passes through the village of Newburg, into Leon River (tributary to Little River and thus to the Brazos) 2 miles north of Siloam. Brownwood and Hamilton topographic maps.

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South Mayde Creek.—Harris County; rises 3½ miles north of Katy, near South Mayde School; flows southeasterly 15½ miles into Buffalo Bayou (tributary to San Jacinto, Trinity, and Galveston bays, and thus to the Gulf of Mexico); intermittent. Katy, Addicks, and Hillendahl topographic maps.

South Mesquite Creek.—Dallas County; rises near Reinhardt; flows southeasterly 13 miles into East Fork of Trinity River (tributary to Trinity River) about 2 miles east of Haughts Store. Dallas and Barnes Bridge topographic maps.

South Noland Creek.—Bell County; rises 3 miles west of Killeen, in western part of county; flows easterly 18 miles to a point 3 miles northwest of Belton, where it enters Noland Creek (tributary to Leon River and thus through Little River to the Brazos). Gatesville topographic map.

South Palo Pinto Creek.—Palo Pinto and Eastland counties; rises 4 miles north of Desdemona in eastern part of Eastland County; flows northerly 19 miles to its junction with North Palo Pinto Creek to form Palo Pinto Creek (tributary to Brazos River) at Mingus in southwestern part of Palo Pinto County. Eastland, Stephenville, and Palo Pinto topographic maps.

South Paluxy Creek.—Erath County; rises 6 miles north of Stephenville; flows northeasterly 12 miles to its junction with North Paluxy Creek to form Paluxy Creek (tributary to Brazos River) 1 mile west of Bluff Dale in northern part of county. Stephenville topographic map.

South Fork Pecan or Chambers Creek.—Johnson and Ellis counties; rises 4 miles south of Cuba in the south central part of Johnson County; flows southeasterly 20 miles to a point in the southwestern part of Ellis County, where it joins the North Fork of Pecan Creek forming Pecan Creek (tributary to Richland Creek and Trinity River). Cleburne topographic map.

South Plum Creek.—Moore County; rises in south central part of county; flows easterly 8 miles into Plum Creek (tributary to Canadian River, which discharges into the Mississippi, through Arkansas River) near Potter-Moore County line.

South Rocky Creek.—Burnet County; rises 3 miles northwest of Sunnylane in northeastern part of county; flows easterly 14 miles to its junction with North Rocky Creek to form Rocky Creek (tributary to Lampasas River and thus through Little River to the Brazos) southwest of the village of Oakalla. Georgetown and Burnet topographic maps.

South Sandy Creek.—Colorado and Lavaca counties; small stream flowing southeasterly along the line between Colorado and Lavaca counties to its junction with Sandy Creek (tributary to Navidad River, the Lavaca, Matagorda Bay, and Gulf of Mexico) in the southern part of Colorado County.

South Walnut Creek.—Robertson County; rises at Owensville; flows westerly into Walnut Creek (tributary to Little Brazos River and thus to the Brazos) 4 miles northeast of Calvert.

South Willow Creek.—Llano County; a small intermittent tributary through North Willow Creek to San Fernando Creek and thus through Llano River to the Colorado in the northwestern part of the county; *length*, 4 miles. Llano topographic map.

South Concho Draw.—Schleicher County; an intermittent water *course* in the northern part of the county; flows northward 10 miles into South Concho River (tributary to Concho River and thus to the Colorado). Fort McKavett and San Angelo topographic maps.

South Bosque River.—McLennan County; rises 3 miles southeast of Oglesby near Coryell-McLennan County line; flows northeasterly 24 miles into Bosque River (tributary to Brazos River) 5 miles above mouth of Bosque River, 4 miles northwest of Waco in central part of county. Temple and Waco topographic maps.

South Bosque River.—Erath County; rises 5 miles north of Lingleville; in western part of county; flows southeasterly 14 miles into Bosque River (tributary to the Brazos River) 1 mile north of Stephenville. Stephenville topographic map.

South Concho River.—Tom Green and Schleicher counties; rises 8 miles northeast of Eldorado in the central part of Schleicher County at an approximate altitude of 2,400 feet above sea level; flows northward 13 miles through Schleicher, then 28 miles through Tom Green County to its confluence with North Concho River forming Concho River (tributary to the Colorado) in the city of San Angelo near the central part of Tom Green County; drainage area, 3,260 square miles. Sherwood and San Angelo topographic maps. (See Concho River).

South Fork of Sabine River.—Rockwall and Hunt counties; rises about 2 miles east of Chisholm in Rockwall County; flows easterly 19 miles to its junction with Caddo Fork of Sabine River (thence to Sabine River) in the southeastern corner of Hunt County.

South Llano River.—Edwards and Kimble counties; rises in the north central part of Edwards County at approximate altitude, 2,300 feet above sea level; flows northeastward 55 miles to its confluence with North Llano River at Junction near the center of Kimble County, forming Llano River (tributary to Colorado River). A large part of the flow of Llano River is contributed by South Llano River. (See Llano River). Rock Springs topographic map.

South Pease River.—Motley, Dickens, and Cottle counties; formed about 4 miles southeast of Roaring Springs in southwestern part of Motley County by confluence of Olive Fork of Pease River and Walnut Creek; flows northeastward into Middle Pease River (tributary through Pease River to Red River and thus to the Mississippi) about 10 miles northwest of Paducah in western part of Cottle County; length, 42 miles.

South Sulphur River.—Fannin, Hunt, Delta, Lamar, and Hopkins counties; rises in the southern part of Fannin County about a mile south of Bailey; flows southeasterly and easterly 60 miles to its junction with North Sulphur River forming Sulphur River (tributary to Red River and thus to the Mississippi) at the corner of Lamar, Delta, and Hopkins counties, 4 miles northeast of Sulphur Bluff.

South Wichita River (Salt Fork of Wichita, or South Fork of Big Wichita).—Dickens, King, Knox, and Baylor counties; rises in the northeastern part of Dickens County; flows easterly 85 miles to its junction with North Wichita River to form Wichita River (tributary to Red River, which discharges into the Mississippi) east of Noview in northwestern part of Baylor County.

Sowells Creek.—Comanche and Erath counties; rises near Dublin in southern part of Erath County; flows southwesterly into Leon River (tributary to Little River and thus to the Brazos) 2 miles southwest of Camden in southeastern part of Comanche County. Stephenville and Hamilton topographic maps.

Spade Branch.—Dickens County; small stream flowing into Duck Creek (which discharges into Brazos River through the Salt Fork of the Brazos) 3 miles southeast of Spur in southern part of county; length, 8 miles.

SPANISH OAK CREEK.—Caldwell County; rises south of Dale in the northeastern part of the county; flows into Dry Creek (tributary through Plum Creek to the San Marcos River and thus to the Guadalupe). San Marcos topographic map.

SPANISH OAK CREEK.—Travis and Burnet counties; small stream following line between Travis and Burnet counties 3 miles to its junction with Colorado River, 3 miles southeast of Smithwick. Burnet topographic map.

SPARERIB CREEK.—Burnet County; rises 4 miles northwest of Fairland in the southern part of county; flows southeastward 6 miles into Backbone Creek (tributary to Colorado River) about 1 mile north of Granite Mountain. Burnet topographic map.

SPEER CREEK.—San Augustine County; rises about 6 miles west of San Augustine; flows southwesterly 17 miles into Attoyac Bayou (tributary to Angelina river and thus to Neches River) west of Broaddus in the southwestern part of the county.

SPENCER CREEK.—Presidio County; rises at Spencer Spring 9 miles west of Shafter in western part of county; flows southwesterly into Rio Grande at Borracho; intermittent. Ruidoso and Shafter topographic maps.

SPICER CREEK.—Bastrop County; just north of Bastrop in the north central part of the county; tributary through Piney Creek to Colorado River. Bastrop topographic map.

SPINDLETOP BAYOU.—Jefferson and Chambers counties; rises in the southwestern part of Jefferson County; flows westerly into Elm Bayou (tributary to East Bay Bayou, thence to East Galveston Bay and Gulf of Mexico).

SPILLER OR BUCK CREEK, NORTH FORK.—Donley and Collingsworth counties; rises in the southeastern part of Donley County; flows southeasterly 10 miles into Spiller Creek (tributary to Prairie Dog Town Fork of Red River and thus through Red River to the Mississippi) in the southwestern part of Collingsworth County.

SPILLER OR BUCK CREEK.—Donley, Collingsworth, and Childress counties; rises in southeastern part of Donley County; flows southeasterly 49 miles to its intersection with Texas-Oklahoma boundary line, then three miles through Harmon County, Oklahoma, into Prairie Dog Town Fork of Red River (tributary to Red River and thus to the Mississippi).

SPRING BRANCH.—Waller County; rises 5 miles east of the town of Hempstead; flows southwesterly 15 miles into the Brazos.

SPRING BRANCH.—Harris County; small stream flowing southerly 2½ miles into Buffalo Bayou (tributary to Galveston Bay and thus to Gulf of Mexico) in the southern part of the county. Hillendahl and Houston Heights topographic maps.

SPRING BRANCH.—King County; small stream rising in the eastern part of county and flowing northerly 5 miles into South Wichita River (tributary to Wichita River and thus through Red River to the Mississippi).

SPRING BRANCH.—Jones County; an intermittent stream rising 5 miles east of Anson in northeastern part of county; flows northeasterly 10 miles to a point near Avoca, where it enters California Creek and thus through Clear Fork of Brazos River to the Brazos. Anson topographic map.

SPRING BRANCH.—Bastrop County; rises in the south central part of the county; flows into Sandy Creek and thus through Walnut Creek to Colorado River; length, 2 miles. Flatonia topographic map.

SPRING CREEK.—Cooke County; flows southeasterly 15 miles into Elm Fork of Trinity River (tributary to the Trinity) in the southern part of the County. Gainesville topographic map.

SPRING CREEK.—Dawson County; a stream approximately 10 miles in length rising in the northeastern part of the county and flowing into Colorado River.

SPRING CREEK.—Edwards County; a tributary in the southeastern part of the county; flows northeasterly 8 miles to its junction with Pulliam Creek thence to Nueces River north of Military Mountain. Nueces topographic map.

SPRING CREEK.—Gillespie County; a stream flowing southeasterly 13 miles to its junction with Pedernales River (tributary to Colorado River) 9 miles west of Fredericksburg in the southwestern part of the county. Kerrville topographic map.

SPRING CREEK.—Gonzales County; rises northwest of Possumtrot in northern part of county; small intermittent tributary to Sandy Fork of Peach Creek, thence to Peach Creek and Guadalupe River. Flatonia topographic map.

SPRING CREEK.—Hutchinson and Moore counties; rises 3 miles west of White Deer Creek in northern part of Carson County; flows northerly into Canadian River (tributary through Arkansas River to the Mississippi) 4 miles east of Plemons in eastern part of Hutchinson County.

SPRING CREEK.—Jasper County; flows southwesterly 5 miles into Neches River in the northwestern part of the county.

SPRING CREEK.—Nolan and Taylor counties; rises 4 miles southwest of Dora in the southeastern part of Nolan County; flows southeastward 12 miles in Valley Creek (tributary to Colorado River) 5½ miles east of Hylton in the southwestern part of Taylor County. Sweetwater topographic map.

SPRING CREEK.—Parker County; rises south of Weatherford along the Santa Fe Railway in southern part of the county; flows southerly 7 miles into Brazos River 3 miles northwest of Center Mill. Weatherford topographic map.

SPRING CREEK.—Potter and Moore counties; a stream 2 miles long rising in the northeastern corner of Potter County and flowing northerly into Canadian River (tributary to Arkansas River and thus to the Mississippi) in the southeastern corner of Moore County.

SPRING CREEK.—Schleicher, Crockett, Irion and Tom Green counties; rises 4 miles south of the corner common to Schleicher, Irion, and Crockett counties; flows northeastward 27 miles through Irion County, then 13 miles through Tom Green County into Middle Concho River (tributary to South Concho River, and thus through the Concho to Colorado River) 8 miles southwest of San Angelo in the western part of Tom Green County. Valley lands are irrigated in vicinity of Mertzon and Sherwood. Sherwood topographic map.

SPRING CREEK.—Victoria County; small stream in central part of county; joins Guadalupe River 2 miles north of the town of Victoria.

SPRING CREEK.—Anderson County; small stream in northwestern part of county flowing southwesterly 7 miles into Trinity River.

SPRING CREEK.—Bandera County; small intermittent stream in eastern part of county; joins Medina River (tributary through San Antonio River to the Guadalupe) 3½ miles northwest of Bandera.

SPRING CREEK.—Blanco County; flows into North Grape Creek (tributary through Pedernales River to Colorado River) west of Sandy in the western part of the county; length, 4 miles. Fredericksburg and Blanco topographic maps.

SPRING CREEK.—Bowie County; rises about 7 miles southwest of Texarkana in western part of county; flows southerly 5½ miles into Sulphur River (tributary to Red River and thus to the Mississippi) about 4 miles west of Leary. Texarkana topographic map.

SPRING CREEK.—Bosque County; rises 2 miles east of Spring Creek Gap in western part of county; flows southeasterly 15 miles into Meridian Creek (tributary through Bosque River to the Brazos) 8 miles southwest of Meridian. Meridian topographic map.

SPRING CREEK.—Burnet County; rises three miles west of the town of Burnet in the western part of the county; flows westward 7 miles into Colorado River. Burnet topographic map.

SPRING CREEK.—Burleson County; rises 3 miles north of Caldwell in northern part of county; flows easterly 7 miles into Brazos River.

SPRING CREEK.—Collin and Dallas counties; rises in southwestern part of Collin County; flows southeasterly 8 miles into Rowlett Creek (tributary to East Fork of Trinity River and thus to the Trinity) in northeastern corner of Dallas County 4 miles northeast of Garland. Dallas topographic map.

SPRING CREEK.—Crosby County; rises in southwest part of county; flows southeasterly 6 miles into North Fork of Double Mountain Fork of Brazos River (tributary through the Double Mountain Fork to the Brazos) near Crosby-Garza County line.

SPRING CREEK.—Grayson County; headwater stream of East Fork of Trinity River (tributary to Trinity River) in southern part of county.

SPRING CREEK.—Donley County; a stream 6 miles long flowing southerly in northwestern part of county and entering Salt Fork of Red River (tributary to Prairie Dog Town Fork of Red River and thus through the Red to Mississippi).

SPRING CREEK.—Donley County; small stream flowing southerly through east central part of county into Cow Creek (tributary through Salt Fork of Red River to Prairie Dog Town Fork of the Red and thus through Red River to the Mississippi); length 2½ miles.

SPRING CREEK.—Donley County; rises about 7 miles northeast of Clarendon; flows northeasterly 2½ miles into Salt Fork of Red River (tributary through Prairie Dog Town Fork of Red River to the Red and thus to Mississippi River).

SPRING CREEK.—Erath County; an eastward flowing stream 8 miles long, joining Bosque River (tributary to the Brazos) 3 miles west of Hico in southern part of county. Hamilton and Stephenville topographic maps.

SPRING CREEK.—Gillespie and Mason counties; a stream in the southeastern part of Mason County and northern part of Gillespie County; flows 6 miles to its junction with Beaver Creek and thus through Llano River to the Colorado. Mason and Kerrville topographic maps.

SPRING CREEK.—Grayson County; rises near Macomb; flows southwesterly 8 miles into Range Creek (tributary to Isle du Bois Creek, and thus through Elm Fork of Trinity River to the Trinity) about 3 miles south of Collinsville; intermittent. Denison topographic map.

SPRING CREEK.—Grimes County; tributary to Holland Creek (which discharges into Navasota River and thus to the Brazos) northeast of the town of Navasota. Navasota topographic map.

SPRING CREEK.—Kerr County; flows into Johnson Creek (tributary to the Guadalupe) at Resort in the northeastern part of county. Kerrville topographic map.

SPRING CREEK.—Kendall County; small stream flowing through southeastern part of county into Guadalue River.

SPRING CREEK.—Leon County; rises about 1 mile southeast of Robbins; flows southeasterly 7 miles into Boggy Creek (tributary to Trinity River).

SPRING CREEK.—Live Oak County; rises in the southwestern part of the county; flows northeasterly 18 miles into Nueces River at Mikeska.

SPRING CREEK.—Motley County; rises in the eastern part of county; flows eastward 8 miles into Middle Pease River (tributary through Pease River to Red River and thus to the Mississippi) about 2 miles north of Teepee City.

SPRING CREEK.—Motley County; small stream in southwestern part of county flowing into Walnut Creek (tributary to South Pease River and thus through Middle Pease, Pease, and Red rivers to the Mississippi).

SPRING CREEK.—Robertson County; small stream flowing southwesterly 11 miles into Little Brazos River (tributary to Brazos River) north of Benchley.

SPRING CREEK.—San Saba County; rises north of the town of San Saba in northeastern part of the county; flows 5 miles into Colorado River. San Saba topographic map.

SPRING CREEK.—Sabine County; small stream flowing into Richland Creek (thence to Sixmile Creek and Sabine River) in southeastern part of county.

SPRING CREEK.—Shackelford County; rises near Callahan-Shackelford county line; flows northerly 12 miles to a point 2 miles south of Rising Sun in western part of Shackelford County, where it enters Deadman Creek which discharges into Brazos River through the Clear Fork of the Brazos. Anson and Albany topographic maps.

SPRING CREEK.—Waller, Harris, and Montgomery counties; rises in northeastern part of Waller County; flows easterly forming the boundary between Waller and Harris counties for 11 miles (practically from its source) then 40 miles between Montgomery and Harris counties to its junction with San Jacinto River (thence to Galveston Bay and Gulf of Mexico), 2 miles north of Humble. Joseph, Waller, Hockley, Rose Hill, Stuebner, Spring and Weeden topographic maps.

SPRING CREEK.—Young, Archer, and Throckmorton counties; a southward flowing stream joining Brazos River at Spring Creek in northeastern part of Throckmorton County; length, 7 miles.

SPRING GULLY.—Harris County; rises in northwestern part of county, 3½ miles northeast of Louetta; flows southeasterly 3½ miles into Cypress Creek (tributary to Spring Creek); intermittent. Louetta and Spring topographic maps.

SPRING LAKE.—(McFarland Lake); Bowie County; about 4½ miles southeast of Maud, in southern part of county; formed by an old channel of Sulphur River (which discharges into the Mississippi through Red River). New Boston topographic map.

SPUR CREEK.—Runnels County; a small intermittent stream south of Ballinger in the southern part of the county; flows 4 miles into Colorado River. Ballinger topographic map.

SPRING GULLY.—Harris County; formed 4 miles southwest of Crosby by Ingrando Marsh; flows easterly one-half mile; from this point it continues as Granite Creek (tributary to San Jacinto River and thus to Gulf of Mexico); intermittent. Harmaston topographic map.

SQUAW CREEK.—Gillespie County; rises 7 miles southwest of Cherry Springs; flows northerly 8 miles into Spring Creek (tributary to Threadgill Creek, thence through Beaver Creek to Llano River and thus to the Colorado); intermittent. Kerrville topographic map.

SQUAW CREEK.—Hardeman County; a stream 6 miles long flowing easterly through northeastern part of county to Red River, which discharges into the Mississippi.

SQUAW CREEK.—Parker County; small stream flowing into Clear Fork of Trinity River (tributary to West Fork of Trinity River and thus to the Trinity) northeast of Annetta. Weatherford topographic map.

SQUAW CREEK.—Somervell and Hood counties; rises near Tolar in southern part of Hood County; flows southeasterly 20 miles into Brazos River, 3 miles northeast of Glenrose in eastern part of Somervell County. Granbury topographic map.

SQUAW CREEK.—Throckmorton County; a northerly flowing stream 3 miles long joining Millers Creek (tributary to the Brazos) in northwestern part of county.

SQUIRREL CREEK.—Cooke County; small intermittent stream flowing into Dry Elm Creek (tributary to Elm Fork of Trinity River, and thus to the Trinity) about 3 miles northeast of [illegible]. Gainesville topographic map.

SQUIRREL CREEK.—Grayson County; rises about 3 miles northwest of Howe; flows southerly 6 miles into East Fork of Trinity River (tributary to Trinity River) near south line of Grayson County.

STAG BRANCH.—Runnels County; an intermittent stream 2 miles in length rising southeast of Ballinger in the southern part of the county and flowing into Colorado River. Ballinger topographic map.

STAMPEDE CREEK.—Bell and McLennan counties; rises near Moody in southern part of McLennan County; flows southwesterly 9 miles into Leon River River (tributary to Little River and thus to the Brazos) 2 miles northeast of Moffat. Temple topographic map.

STAMPEDE CREEK.—Coryell County; an intermittent stream east of Pidcoke in southern part of county; flows southerly 7 miles into Cowhouse Creek (tributary to Leon River and thus through Little River to the Brazos). Gatesville topographic map.

STANLEY CREEK.—Angelina County; small stream flowing northeasterly 9 miles into Angelina River (tributary to the Neches) in the northeastern part of the county.

STAR HOLLOW CREEK.—Hood County; flows northeasterly 5 miles to its junction with Robinson Creek (tributary to Brazos River) 5½ miles northwest of Thorpe Springs in northern part of county. Granbury topographic map.

STATE LINE CREEK.—Cass County, Tex., Miller County, Ark., and Caddo Parish, La.; rises at Bloomburg in northeastern part of Cass County, Tex.; flows southeasterly 14 miles, crosses a corner of Arkansas and enters Black Bayou (tributary to Caddo Lake and thus through Red River to the Mississippi) in Caddo Parish, La.

STATION BRANCH.—Johnson and Hood counties; rises in western part of Johnson County, 2½ miles northeast of Falls; flows southwesterly 4 miles into Hood Creek (tributary to Fall Creek and thus to Brazos River). Granbury topographic map.

STATION CREEK.—Coryell County; small stream flowing southerly to a point near Eagle Springs in eastern part of county, where it enters Leon River and thus through Little River to the Brazos; length, 6 miles. Gatesville and Temple topographic maps.

STEELE CREEK.—Bosque County; rises two miles west of Walnut in northern part of county; flows easterly 23 miles into Brazos River 2 miles east of Fowler. Granbury and Cleburne topographic maps.

STEELMAN BRANCH.—Montague County; a small intermittent stream flowing into Mallard Creek (tributary to Denton Creek, then through Elm Fork of the Trinity to Trinity River) northwest of Mallard. Montague topographic map.

STEETES CREEK.—Robertson and Limestone counties; rises 5 miles northwest of Thornton in southwestern part of Limestone County; flows southeasterly 27 miles into Navasota River (tributary to Brazos River) 7 miles south of the Limestone-Robertson County line.

STEPHENS CREEK.—Wichita County; rises 7 miles northwest of Iowa Park; flows southerly 8½ miles into North Fork of Buffalo Creek (tributary through Wichita River to Red River and thus to the Mississippi); intermittent. Clara and Iowa Park topographic maps.

STEPPE CREEK.—Brown County; a stream to the north and west of Ricker in the southeastern part of the county; flows into Pecan Bayou and thus to Colorado River; length, 13 miles. Brownwood topographic map.

STERLING CREEK.—Reagan, Glasscock, and Sterling counties; rises in the northern part of Reagan County; flows northeastward 35 miles into North Concho River (tributary to Concho and Colorado rivers) 4 miles southeast of Sterling City near the center of Sterling County.

STEWART CREEK.—Bowie County; a small stream rising about 3 miles northeast of Sims and flowing into Anderson Creek (tributary to Sulphur River and thus through Red River to the Mississippi) in western part of county. New Boston topographic map.

STEWARTS CREEK.—Denton County; joins Elm Fork of Trinity River (tributary to Trinity River) in southeastern part of county.

STIFF OR BUFFALO CREEK.—Collin County; rises 2 miles east of Melissa; flows southeasterly 6 miles into Sister Grove Creek (tributary to East Fork of Trinity River, and thus to the Trinity) about 2 miles south of Altoga.

STILLS CREEK.—Anderson County; rises about 3 miles southeast of Palestine; flows easterly 12 miles into Neches River in the eastern part of county.

STILLHOUSE CREEK.—Montague County; small intermittent stream flowing to a point north of Salona, where it enters Denton Creek, and thus to Elm Fork of Trinity River (tributary to the Trinity). Montague topographic map.

STILLWELL CREEK.—Brewster County; an intermittent stream in southeastern part of the county; flows southeasterly 13 miles into Rio Grande, 15 miles northeast of Boquillas. Chisos Mountains topographic map.

STINK CREEK.—Nolan County; an intermittent stream 7 miles long flowing into Sweetwater Creek (tributary through Clear Fork of Brazos River to the Brazos) 2 miles east of Eskota in northeastern part of county. Sweetwater and Roby topographic maps.

STONE BAYOU.—Shelby County; small tributary to Sabine River north of Hamilton in southeastern part of county.

STONE BRIDGE CREEK.—Mason County; a small intermittent stream flowing through the eastern part of the county south of Bodeville into Herman Creek (tributary to Llano River and thus to the Colorado); length, 4 miles. Mason topographic map.

STONE COAL BRANCH.—Robertson County; small stream flowing southwesterly 3½ miles into Duck Creek (tributary through Navasota River to the Brazos) north of Lake.

[illegible] Creek.—[illegible] County; rises in western part of county; flows south[illegible] [illegible] miles into Navasota River and thus to the Brazos. Navasota [illegible] map.

[illegible] Creek.—[illegible] County; rises in the central part of the county; flows [illegible] miles into [illegible] River.

[illegible] Creek.—[illegible] County; a stream flowing northeasterly 4 miles into [illegible] Creek and thus to Brazos [illegible] Mill in northern part of county. [illegible] map.

[illegible] Creek.—[illegible] and Maverick counties; small intermittent tributary [illegible] Nueces River; rises in Anacacho Mountains [illegible] County; flows southward 11 miles into [illegible] Maverick County. Brackett topographic map.

[illegible] Creek.—Cherokee and Rusk counties; rises in eastern part of Cherokee [illegible] Cherokee and Rusk counties; flows south[illegible] River (thence to Nueces River) [illegible] Rusk County.

[illegible] Creek.—[illegible] easterly [illegible] miles into Brazos River [illegible] eastern part of county. Granbury [illegible] map.

[illegible] Creek.—[illegible] County; rises in northern part of the county [illegible] southeasterly [illegible] miles into San Bernard River [illegible].

[illegible] Creek.—[illegible] County; rises about 3 miles south of Gilmer; flows [illegible] Big Cypress Creek (tributary to Caddo Lake, and thus through Red River to the Mississippi).

[illegible] Lake.—[illegible] County; in eastern part; an expansion of North [illegible] of Red River, tributary to Red River, which discharges into the Mississippi. [illegible] square mile.

[illegible] Creek.—[illegible] County; small tributary to Housing Bayou, thence to Sabine River about [illegible] miles south of Hemphill.

Sugar Creek.—Upshur County; rises about 2 miles south of Gilmer in central part of county; flows northeasterly 5 miles into Little Cypress Creek (tributary to Caddo Lake, thence to Red River and thus to the Mississippi).

Sulphur Branch.—[illegible] County; [illegible] northwest of Moulton in northeastern part of county; [illegible] Peach Creek, and thus to Guadalupe River. Flatonia topographic map.

Sulphur Branch.—Tarrant County; rises 1½ miles northwest of Bedford; flows southerly 3½ miles into a creek not named on the map (tributary to West Fork of Trinity River). Fort Worth topographic map.

Sulphur Creek.—Culberson County; an intermittent stream 8½ miles north of Van Horn in southwestern part of county; flows easterly 15 miles, where it sinks in sands. Van Horn topographic map.

Sulphur Creek.—Lampasas County; formed in the town of Lampasas in southern part of county by union of Burleson and Donaldson creeks and several large springs; flows easterly 10 miles into Lampasas River (tributary to Brazos River through Little River). Lampasas topographic map.

Sulphur Springs Creek.—Terry, Dawson, and Martin counties; an intermittent stream rising north of Pride in southeastern corner of Terry County; flows southeastward 65 miles into Girands Creek (tributary to Colorado River), northeast of Stanton in the eastern part of Martin County.

SULPHUR RIVER.—Red River, Franklin, Titus, Morris, Bowie, and Cass counties; formed 4 miles northeast of Sulphur Bluff at the eastern extremity of Delta County by junction of North and South Sulphur rivers; flows easterly 75 miles, crosses eastern boundary of State 10 miles south of Texarkana, thence continuing in an easterly direction 15 miles to a point about 2 miles northeast of Doddridge in the southern part of Miller County, Ark., where it enters Red River (tributary to the Mississippi). Daingerfield, New Boston, Linden, Texarkana, and Atlanta topographic maps.

SUNFLOWER CREEK.—Wilbarger and Wichita counties; rises in eastern part of Wilbarger County; flows southeasterly 8 miles into Beaver Creek (tributary to Wichita River and thus through Red River to the Mississippi) in the southeastern part of Wichita County.

SUPPLE JACK CREEK.—Lavaca County; rises 3 miles southeast of Yoakum; flows southeastward 10 miles into Clarks Creek (tributary to Lavaca River, Matagorda Bay and Gulf of Mexico) in southwestern part of county.

SUTHERLAND CANYON.—King and Stonewall counties; small intermittent stream 5 miles long flowing southerly into Salt Fork of Brazos River and thus to the Brazos.

SUTHERLANDS CREEK.—Jackson County; small stream in northern part of county flowing southeasterly into Brushy Creek (thence to Sandy Creek, Navidad and Lavaca rivers, Matagorda Bay, and Gulf of Mexico).

SWAGER CREEK.—Shackelford County; rises 8 miles northwest of Albany; flows northwesterly 12 miles into Clear Fork of Brazos River (tributary to the Brazos) in northwestern part of county. Anson and Albany topographic maps.

SWAUANO CREEK.—Titus County; rises about 6 miles west of Mount Pleasant; flows southerly 14 miles into Big Cypress Bayou (tributary through Caddo Lake to Red River and thus to the Mississippi) in the southeastern part of county.

SWEETWATER CREEK.—Comanche County; rises near Logan Gap 2 miles east of Whitville in southern part of county; flows northeasterly 15 miles into Copperas (Rush) Creek (tributary through Leon and Little rivers to the Brazos) 7 miles southwest of DeLeon. Brownwood and Eastland topographic maps.

SWEETWATER CREEK.—Jones, Fisher, and Nolan counties; rises near Maryneal; flows northeastward 45 miles into Clear Fork of Brazos River (which discharges into the Brazos) 4 miles southeast of Newman in western part of Jones County. Sweetwater and Roby topographic maps.

SWINDLERS CREEK.—Newton County; small stream flowing into Plum Creek (tributary to Sabine River through Little Cow Creek) about 4 miles east of Burkeville.

SWAN LAKE.—Galveston County; south of Texas City in central part of the county on the west side of Galveston Bay, thence to Gulf of Mexico.

SYCAMORE BRANCH.—Burnet County; stream 2 miles long in the northwestern part of the county; tributary to Colorado River. Burnet topographic map.

SYCAMORE CREEK.—Burnet County; small stream flowing into Colorado River 4 miles east of Marble Falls in the southern part of the county; length, 7 miles. Burnet topographic map.

SYCAMORE CREEK.—Cooke County; a small intermittent stream flowing into Red River (tributary to the Mississippi) in extreme northeastern part of county. Denison topographic map.

... Kinney counties; rises ... southerly 16 miles through ... County into ... ; length, 28 miles. ...

... counties; rises in the southeastern ... southwesterly 11 miles through ... western part of Uvalde County ... to the Nueces near ...

... Val Verde counties; rises ... southerly into Kinney County, ... Kinney and Val Verde counties ... boundary of Val Verde and Kinney ... miles southeast of the ...

... east of Bunker Hill in eastern ... Richardson Creek (tribu- ... near Hood-Erath County ... maps.

... intermittent stream in central ... River (tributary through ... west of Busyton. Hamilton and ...

... north of a point where ... County line by the junc- ... Creek; flows southwesterly ... Grande 5 miles south-

... north central part of ... confluence with West Fork of ... tributary to Rio Grande ... Railroad crosses Kinney-

... miles north of Crowley in the ... 12 miles into West ... River 1 mile east of Fort

... Kinney counties; rises in north- ... 22 miles to its union ... Sycamore Creek (tributary ...

SYCAMORE CREEK.— ... southerly ... part of the county; flows ... Fredericksburg ... miles south of Sisterdale.

TABLE ROCK CREEK.— ... part of county ... Mountains in southern ... mary through ... Cowhouse Creek (trib- ... Pidcoke. Gatesville ... 4 miles southeast of ...

TALLACAHE CREEK.— ... Beeville in central part of county; flows ... Creek (tributary to Aransas River. ...

ᴀɴᴄʜᴀ Bayou.—Shelby County; rises about 2 miles north of Timpson in the northwestern part of the county; flows easterly 36 miles into Sabine River 5 miles southeast of Dacha.

ᴀɴᴄʜᴀ Bayou, South Fork.—Shelby County; rises about 8 miles southwest of Shelbyville; flows northeasterly 18 miles into Tancha Bayou (tributary to Sabine River) 9 miles northeast of Shelbyville.

ᴀɴᴋ Creek.—King County; rises in northwestern part of county; flows southeasterly 7 miles into Willow Creek (tributary to South Wichita River and thus through Wichita and Red rivers to the Mississippi).

ᴀɴᴋᴀʀᴀ Creek.—Karnes County; north of Helena in the eastern part of the county; flows southwesterly 11 miles into Ecleto Creek and thus through San Antonio River to the Guadalupe.

ᴀɴᴋᴇʀsʟʏ Creek.—Titus County; rises about 5 miles northwest of Mount Pleasant in western part of county; flows southeasterly 10 miles into Big Cypress Bayou (tributary to Caddo Lake and thus through Red River to the Mississippi), in the southern part of the county.

'ᴀɴʏᴀʀᴅ Branch.—Bell County; rises in northern part of county; flows into Leon River and thus to Little River west of Howard; intermittent. Tempel topographic map.

'ᴀᴘᴀᴅᴏ Canyon.—Presidio County; an intermittent stream flowing southwesterly 8 miles entering Rio Grande 4 miles southeast of Santiago in southern part of county. Polvo topographic map.

Tᴀʀᴀɴᴄᴀʜᴜᴀs Creek.—Duval County; small intermittent tributary to San Diego Creek (thence to Gulf of Mexico through Chiltipin, Pinias, and Santa Petronilla creeks and Baffins Bay) in northeastern part of county.

Tᴀʀᴋɪɴɢᴛᴏɴ Creek.—Liberty County; rises in the northwestern part of the county; flows southerly to its junction with Luces Bayou (tributary to East San Jacinto River, San Jacinto River, and Gulf of Mexico) in the west central part of the county.

Tᴀʀʀᴀɴᴛ Creek.—Motley County; rises in southeastern part of county; flows northeasterly 4½ miles into Salt Creek (tributary through South Pease to Middle Pease River and thus through Pease and Red rivers to the Mississippi).

Tᴀʏʟᴏʀs Bayou.—Harris County; rises in the southeastern corner of the county; flows southwesterly 4½ miles into Taylor Lake, thence to Clear Lake (thence to Galveston Bay and thus to Gulf of Mexico) about 1½ miles west of Seabrook; tidal about 2 miles in its lower course. La Porte and Seabrook topographic maps.

Tᴀʏʟᴏʀs Bayou, North Fork.—Jefferson County; rises about 2 miles north of Morey in the western part of the county; flows southeasterly into Taylors Bayou and thus through Sabine Lake to Gulf of Mexico, 2½ miles southwest of LaBelle; length, 8 miles.

Tᴀʏʟᴏʀs Bayou.—Jefferson County; rises in western part of the county in a fresh-water marsh north of Hamshire; flows easterly 30 miles into Sabine Lake (thence through Sabine Pass to the Gulf of Mexico) 2 miles south of Port Arthur; tidal to a point near the center of county; channel irregular; 10 to 15 feet deep and 200 to 400 feet wide along the lower portion.

Tᴀʏʟᴏʀ Creek.—Lampasas and Coryell counties; rises near Beecham Gap in southern part of Coryell County; flows southwesterly 7 miles, passing through the town of Kempner into Lampasas River (tributary through Little River to the Brazos) in southeastern part of Lampasas County. Gatesville topographic map.

[illegible] —[illegible] County; rises [illegible] miles northwest of Albany; flows [illegible] Creek tributary through Clear Fork of [illegible] to the Brazos) [illegible] miles northeast of Round Hill in northern [illegible] topographic map.

[illegible] —[illegible] small tributary to Murvalls Bayou (thence [illegible] in southwestern part of county near Dotson.

[illegible] —[illegible] rises in southwestern part, 3½ miles west [illegible] miles into Rio Grande; intermittent. [illegible] map.

[illegible] —[illegible] rises in northwestern part of county 6½ miles [illegible] easterly [illegible] miles into Caney Creek [illegible] River, thence to the San Jacinto, [illegible] intermittent. Moonshine Hill topo-[illegible]

[illegible] counties; rises about 5 miles south-[illegible] County; flows southeasterly 15 [illegible] to Sabine River) about 3 miles [illegible]

[illegible] small intermittent stream in southwestern [illegible] miles into Chacareco Creek [illegible] Creek).

[illegible] rises [illegible] miles north of Bush in southwestern [illegible] miles into Canadian River (tributary [illegible] the Mississippi) 5 miles northeast [illegible]

[illegible] a stream 5 miles long rising in southwestern [illegible] into Double Mountain Fork of Brazos [illegible] Brazos).

[illegible] a stream 7 miles long flowing easterly [illegible] into Red River, which discharges [illegible]

[illegible] County; rises about 3½ miles northeast of [illegible] county; flows northeasterly 23 miles [illegible] Pease River and thus through Red [illegible] miles north of Tongue City.

TEHUACAN CREEK.—[illegible] rises at Abbott; flows southerly 30 miles into Brazos River [illegible] southeast of Waco in central part of county. Waco topographic map.

TEHUACAN CREEK, EAST FORK.—McLennan County; rises 2 miles northeast of Abbott; flows southeasterly into Tehuacan Creek (tributary to Brazos River) in northern part of State.

TEHUACAN CREEK, SOUTH FORK.—Limestone and McLennan counties; rises in western part of Limestone County; flows southwesterly into Tehuacan Creek (tributary to Brazos River) 5 miles northeast of Waco in central part of county. Waco topographic map.

TEHUACANA CREEK.—Freestone County; rises about 2 miles southwest of Tehuacana; flows northeasterly 29 miles across the county into Trinity River 7 miles north of Troy.

TEHONDA CREEK.—Webb County, an intermittent stream; rises in southwestern part of county; flows southwesterly 7 miles into San Isabel Creek (tributary to Rio Grande) northwest of Laredo.

TEMACANA CREEK.—Nacogdoches County; rises in northern part of county; flows easterly 4 miles into Naconiche Bayou (tributary to Attoyac Bayou and thus through Angelina River to the Neches).

TENMILE CREEK.—Dallas and Ellis counties; rises about 2 miles north of Cedar Hill; flows southeasterly 35 miles into Trinity River in the northeastern part of Ellis County. Dallas topographic map.

TENMILE CREEK.—Fannin County; rises in southeastern part of county; flows southerly 4 miles into North Sulphur River (tributary to Sulphur River, thence through Red River to the Mississippi).

TENMILE CREEK.—Jasper and Orange counties; rises about 3 miles southeast of Evadale in southwestern part of Jasper County; flows southwesterly 6 miles into Neches River in northwestern part of Orange County.

TENMILE CREEK.—Tom Green County; northeast of the City of San Angelo; an intermittent stream flowing 8 miles through the northeastern part of the county into Concho River (tributary to the Colorado). Hayrick topographic map.

TENMILE DRAW.—Sutton County; a small stream flowing through the southeastern part of the county to its junction with North Llano and thus through the Llano into Colorado River; length, 9 miles. Rock Springs topographic map.

TENNEY CREEK.—Caldwell County; rises two miles north of McMalan; flows southwesterly 9 miles into Plum Creek (tributary to San Marcos River and thus to the Guadalupe) 2 miles southwest of Tilmon. San Marcos topographic map.

TEQUESQUITE CREEK.—Kinney and Maverick counties; rises 5 miles south of Newel; flows southwesterly 15 miles into Rio Grande near Quemado.

TERLINGUA CREEK.—Brewster County; small stream rising in the southwestern part of the county and flowing southerly 50 miles into Rio Grande 2 miles south of Terlingua Abaja. Terlingua and Chisos mountains topographic maps.

TENTH CAVALRY CREEK.—Wichita County; rises 7½ miles northeast of Electra near Sunshine School; flows northerly about 7 miles, where it probably sinks into the sands; tributary through Red River to the Mississippi; intermittent. Barwise School and Clara topographic maps.

TERRETT DRAW.—Schleicher and Sutton counties; rises in the northwestern part of Sutton County; an intermittent stream flowing into San Saba River (tributary to the Colorado) a mile west of Fort McKavett in the southeastern part of Schleicher County; length, 17 miles. Fort McKavett topographic map.

TEXAS CREEK.—Cass County; rises near the Texas-Arkansas boundary line 1 mile northeast of Bloomburg; flows northerly 3½ miles into Little Cypress Creek (tributary to Sulphur River and thus through Red River to the Mississippi) about one-half mile southeast of Cass. Atlanta topographic map.

THE BAYOU.—Waller County; rises north of Howth in the northwestern part of the county; flows westerly 6 miles into Brazos River. Howth topographic map.

THE LONG DRAW.—Brewster County; rises 4 miles north of Terlingua; flows southeasterly 12 miles into Terlingua Creek (tributary to Rio Grande) 4 miles north of Terlingua Abaja in southern part of county; intermittent. Terlingua topographic map.

THEISS GULLY.—Harris County; rises in northwestern part of county 2½ miles northeast of Louetta; flows southeasterly 3½ miles into Spring Gully and thus to Cypress and Spring creeks; intermittent. Louetta topographic map.

THIRD CREEK.—Lipscomb County; a stream 6 miles long flowing southerly into Wolf Creek (tributary through North Fork of Canadian River to the Canadian, and thus through Arkansas River to the Mississippi) 8 miles west of Lipscomb in western part of county; intermittent.

[illegible] rises about 4 miles [illegible] county 3 [illegible] Creek to Brazos [illegible] part of the county. [illegible]

[illegible] Williams Creek [illegible] southeastern part of the [illegible]

[illegible] Brazos [illegible] River [illegible]

[illegible] near Sabine [illegible] 12 miles [illegible] Brazos River to the [illegible]

[illegible] Willow Creek [illegible] Clear Fork [illegible] River [illegible]

[illegible] Sulphur [illegible] River [illegible]

[illegible] and Guadalupe [illegible]

[illegible] part of county [illegible] of Brazos.

[illegible] the Trinity [illegible] of Wise County.

[illegible] Prairie Dog Town [illegible] the Mississippi [illegible]

[illegible] mile east of [illegible] Creek [illegible] Hamilton County. [illegible] miles northeast of [illegible] Beaver Creek, [illegible] River [illegible] Kerrville and [illegible]

[illegible] tributary in southern [illegible] River [illegible] the Nueces [illegible] miles. Nueces topographic [illegible]

[illegible] miles west of Percy, near [illegible] flows southeasterly 10 [illegible] tributary to Sulphur River and thus [illegible] the Mississippi [illegible] the southern boundary of the [illegible]

[illegible] 3 miles west of Alvord; flows southeasterly [illegible] Creek (tributary to East Fork of Trinity River [illegible] about 2 miles north of Clear Lake.

ERRA BLANCA CREEK.—Curry County, N. Mex., and Deaf Smith and Randall counties, Tex.; rises in northern part of Curry County, N. Mex., takes an easterly course 75 miles and flows into Prairie Dog Town Fork of Red River (tributary to Red River and thus to the Mississippi) about 4 miles northeast of Canyon in western part of Randall County; dry channel, carrying food waters at rare intervals; course and origin not definite.

IGER CREEK.—Burnet County; flows into Colorado River 2 miles southwest of the town of Marble Falls; length, 4 miles. Burnet topographic maps.

IGER CREEK.—Jasper County; small stream flowing into Baer Creek (tributary to Angelina River, and thus to the Neches) in the northern part of the county.

IGER CREEK.—Mason and McCulloch counties; a stream flowing through the southeastern part of McCulloch and the northeastern part of Mason County into San Saba River east of Camp San Saba; length, 11 miles. Brady and Mason topographic maps.

TIGER CREEK.—San Augustine and Sabine counties; rises about 5 miles southeast of San Augustine in northern part of San Augustine County; flows southeasterly 7 miles into Palo Gaucho Bayou (tributary to Sabine River) in northwestern part of Sabine County.

TIMBER OR CROSS TIMBER CREEK.—Cooke and Grayson counties; rises about 2 miles southwest of Callisburg in Cooke County; flows southeasterly 14 miles into Jordan Creek (tributary through Isle du Bois Creek to Elm Fork of the Trinity, thence to Trinity River) about 2 miles southwest of Collinsville in Grayson County. Gainesville and Denison topographic maps.

TIMBER CREEK.—Fannin County; rises 3 miles northwest of Bonham in western part of county; flows northeasterly 9 miles into Bois d'Arc Creek (tributary to Red River and thus to the Mississippi) 5½ miles north of Dodd City.

TIMBER CREEK.—Hunt County; small stream flowing into Cowleach Fork of Sabine River (thence to Sabine River through Caddo Fork of the Sabine) in the east central part of the county.

TIMBER CREEK.—Roberts County; rises near western line of county in southwestern corner; flows northerly 14 miles into Canadian River (tributary to Arkansas River and thus to the Mississippi) 3 miles north of Peaceville.

TIMMONS CREEK.—Panola County; small stream flowing into Tuttle Creek (tributary to Jackson Creek and thus to the Sabine) in the northwestern part of the county.

TINSLEY CREEK.—Gonzales County; a small intermittent stream; rises in northeastern part of county; flows into Denton Creek (tributary to Peach Creek and thus to Guadalupe River) southwest of Possumtrot. Flatonia topographic map.

TODOS SANTOS CREEK.—Frio County; rises in the southwestern part of the county; flows easterly 11 miles into Leona River (tributary through Frio River to Nueces River) west of Derby.

TOLLETT CREEK.—Lamar County; rises about 4½ miles southeast of Petty in southwestern part of county near western boundary of county; flows southeasterly 6 miles into Bourland Creek (tributary to North Sulphur River, thence to Sulphur River and thus through Red River to the Mississippi).

TOM CREEK.—Comal County; near Cranes Mill in central part of county; small intermittent stream flowing into Guadalupe River.

TOM BALL CREEK.—Motley County; rises in western part of county; flows northeastward 21 miles into Pease River (tributary to Red River and thus to the Mississippi) in northern part of county.

THIRD OR WEST YEGUA CREEK.—Lee and Bastrop counties; rises about 4 miles east of McDade in northern part of Bastrop County; flows easterly 23 miles into Second Yegua Creek (tributary through Yegua Creek to Brazos River) about 2 miles north of Deobau in central part of Lee County. Bastrop topographic map.

THOMAS CREEK.—Bandera County; small tributary to Williams Creek (thence to the Nueces through Hondo and Frio rivers) in the southern part of the county; flows southwesterly 3 miles.

THOMAS LAKE.—Cass County; about 2 miles north of Bryans Mill; length, approximately 5 miles; formerly a channel of Sulphur River (tributary to Red River, which discharges into the Mississippi).

THOMPSON BRANCH.—Jones County; an intermittent stream rising near Skinout Mountain in western part of county and flowing northeasterly 15 miles into California Creek (tributary through Clear Fork of Brazos River to the Brazos) 2 miles southwest of Lenoir. Anson topographic map.

THOMPSON BRANCH.—Parker County; a small stream joining Willow Creek (tributary to South Fork of Trinity River, and thus through Clear Fork of Trinity River and West Fork of the Trinity to Trinity River) about 4 miles north of the town of Weatherford. Weatherford topographic map.

THOMPSON CREEK.—Bowie County; rises about 1 mile southeast of Corley; flows southeasterly 4 miles, passes through Big and Malden Lakes to Sulphur River, which discharges into the Mississippi through Red River; intermittent. New Boston topographic map.

THOMSON CREEK.—Gonzales County; rises near Possumtrot; small intermittent tributary to Sandy Fork of Peach Creek, thence to Peach Creek and Guadalupe River. Flatonia topographic map.

THOMPSONS CREEK.—Brazos County; rises in western part of county; flows southerly 10 miles into Brazos River 7 miles south of Bryan.

THORNSON CREEK.—Jack and Wise counties; small stream flowing into Gentry Creek (tributary to West Fork of Trinity River and thus to the Trinity) in the southeastern part of Jack and southwestern part of Wise County.

THORNTON OR RUSTLERS CREEK.—Hall and Childress counties; rises in eastern part of Hall County; flows northeasterly 10 miles into Prairie Dog Town Fork of Red River (tributary to Red River and thus to the Mississippi) in western part of Childress County.

THOUCHING CREEK.—Tyler and Hardin counties; rises about a mile east of Woodville in Tyler County; flows southerly 27 miles into Alabama Creek (tributary to Neches River) 6 miles northeast of Kountze in Hardin County.

THREADGILL CREEK.—Gillespie and Mason counties; [illegible] northeast of Harper in Gillespie County; flows northe[illegible] Beaver Creek, and thus to Llano River (tributary [illegible] Kerrville [illegible] Mason topographic maps.

THREEMILE CREEK.—Edwards County [illegible] part of county; unites with [illegible] 1½ miles above Ellis; [illegible] map.

THREEMILE CREEK.—Lam[illegible] 3½ mi[illegible] western boundary [illegible] of count[illegible] miles into Nort[illegible]tary [illegible] through Red [illegible] at [illegible] county.

TICKY CREEK.—[illegible] 13 miles [illegible]nity [illegible] and thu[illegible]

Tierra Blanca Creek.—Curry County, N. Mex., and Deaf Smith and Randall counties, Tex.; rises in northern part of Curry County, N. Mex., takes an easterly course 75 miles and flows into Prairie Dog Town Fork of Red River (tributary to Red River and thus to the Mississippi) about 4 miles northeast of Canyon in western part of Randall County; dry channel, carrying food waters at rare intervals; course and origin not definite.

Tiger Creek.—Burnet County; flows into Colorado River 2 miles southwest of the town of Marble Falls; length, 4 miles. Burnet topographic maps.

Tiger Creek.—Jasper County; small stream flowing into Baer Creek (tributary to Angelina River, and thus to the Neches) in the northern part of the county.

Tiger Creek.—Mason and McCulloch counties; a stream flowing through the southeastern part of McCulloch and the northeastern part of Mason County into San Saba River east of Camp San Saba; length, 11 miles. Brady and Mason topographic maps.

Tiger Creek.—San Augustine and Sabine counties; rises about 5 miles southeast of San Augustine in northern part of San Augustine County; flows southeasterly 7 miles into Palo Gaucho Bayou (tributary to Sabine River) in northwestern part of Sabine County.

Timber or Cross Timber Creek.—Cooke and Grayson counties; rises about 2 miles southwest of Callisburg in Cooke County; flows southeasterly 14 miles into Jordan Creek (tributary through Isle du Bois Creek to Elm Fork of the Trinity, thence to Trinity River) about 2 miles southwest of Collinsville in Grayson County. Gainesville and Denison topographic maps.

Timber Creek.—Fannin County; rises 3 miles northwest of Bonham in western part of county; flows northeasterly 9 miles into Bois d'Arc Creek (tributary to Red River and thus to the Mississippi) 5½ miles north of Dodd City.

Timber Creek.—Hunt County; small stream flowing into Cowleach Fork of Sabine River (thence to Sabine River through Caddo Fork of the Sabine) in the east central part of the county.

Timber Creek.—Roberts County; rises near western line of county in southwestern corner; flows northerly 14 miles into Canadian River (tributary to Arkansas River and thus to the Mississippi) 3 miles north of [illegible]

Timmons Creek.—Panola County; small stream flowing into [illegible] (tributary to Jackson Creek and thus to the Sabine) in the [illegible] part of the county.

Tinsley Creek.—Gonzales County; a small intermittent [illegible] eastern pa[illegible]y; flows into Denton Creek [illegible] and thu[illegible]e River) southwest of [illegible] graphic [illegible]

To[illegible] Sa[illegible] ty; rises in the [illegible] erly 4 [illegible] into Leona River [illegible] ted River [illegible] f Derby. [illegible] ises about [illegible] r western [illegible] ng rising in north- [illegible] Creek [illegible] n Fork of Red River, [illegible] hus through [illegible] Crane [illegible] about 4 miles west of Rogan- [illegible] 20 miles; empties into Big Cow [illegible] h of Logtown in the south central [illegible] out 3 miles east of the center of county; [illegible] Neches River.

T[illegible] Creek.—Matagorda County; small stream in southwestern part of the county; flows westerly 2 miles into Tres Palacios Bay, and thence to Matagorda Bay and Gulf of Mexico, below Collegeport.

T[illegible] Creek.—[illegible] County; an intermittent stream rising in eastern part of Quay County, N. Mex., passing into Oldham County, Tex., near southwestern corner, and flowing northeasterly 30 miles into Canadian River (tributary to Arkansas River and thus to the Mississippi) 16 miles north of Adrian in western part of county.

T[illegible] Branch.—[illegible] County; rises 4 miles east of Naples; flows northerly 3 miles into White Oak Creek (tributary through Jennings Lake to Sulphur River and thus through Red River to the Mississippi). Daingerfield topographic map.

Tule Canyon Creek.—Briscoe County; rises in northern part; flows easterly 7 miles into Prairie Dog Town Fork of Red River (tributary to Red River and thus to the Mississippi).

Tule Creek.—Castro, Swisher, and Briscoe counties; rises about one mile east of Arney in northeastern part of Castro County; flows easterly approximately [illegible] miles into Prairie Dog Town Fork of Red River (tributary to Red River and thus to the Mississippi) in northwestern part of Briscoe County. Dry channel carrying only flood waters at rare intervals; its course and origin in upper reaches are definite.

Turkey Creek.—Atascosa County; rises about 5 miles south of Charlotte; flows southeasterly 15 miles into La Parita Creek (tributary to the Nueces through Atascosa and Frio rivers) near Christine.

Turkey Creek.—Atascosa County; rises in the southwestern part of the county; flows southerly 4 miles into [illegible] Creek (tributary to Nueces River through San Miguel and Frio rivers).

Turkey Creek.—Bandera and Uvalde counties; rises in southwestern part of Bandera County; flows southerly 3 miles to its junction with Sabinal River (tributary to the Nueces through Frio River) at Utopia in the northeastern part of Uvalde County.

Turkey Creek.—Bell and Coryell counties; rises 2 miles south of Ruth in southeastern part of Bell County; flows southeasterly 15 miles into Leon River (tributary through Little River to the Brazos) 2 miles northwest of Moffat. Temple and Gatesville topographic maps.

Turkey Creek.—Briscoe and Hall counties; rises in eastern part of Briscoe County; flows southeasterly 4 miles into Little Red River (tributary to Prairie Dog Town Fork of Red River and thus through Red River to the Mississippi) in the western part of Hall County.

Turkey Creek.—Briscoe and Armstrong counties; rises in northern part of Briscoe County; flows northerly about 2 miles into Prairie Dog Town Fork of Red River (tributary to Red River and thus to the Mississippi) about one-half mile north of the southern boundary of the county in southern part of county.

Turkey Creek.—Cass County; small intermittent stream flowing into Mill Creek (tributary to Flat Creek and thus through Black Cypress Bayou to Big Cypress Bayou thence through Caddo Lake to Red River and thus to the Mississippi), about 5 miles west of Linden in western part of county.

Turkey Creek.—Cass County; rises 3 miles east of Hughes Springs in southern part of county; flows southeasterly 4 miles into Hughes Creek (tributary through Black Cypress Bayou to Big Cypress Bayou, thence through Ferry and Caddo lakes to Red River and thus to the Mississippi) 3 miles north of Avinger.

TURKEY CREEK.—Clay County; rises about 11 miles northwest of Henrietta in north central part of the county; flows southeasterly 11 miles into Little Wichita River (tributary to Red River and thus to the Mississippi) about 6½ miles northeast of Henrietta.

TURKEY CREEK.—Donley County; rises about 4½ miles south of Jericho, in the northern part of county; flows southeasterly 10 miles into Salt Fork of Red River (tributary to Prairie Dog Town Fork of Red River and thus through Red River to the Mississippi), 7 miles northeast of Clarendon.

TURKEY CREEK.—Goliad County; rises in the northeastern part of county, flows 7 miles southeasterly into Perdido Creek (tributary to Coleto Creek and thus to Guadalupe River) near Germantown.

TURKEY OR MISTLETOE CREEK.—Goliad County; small stream in northeastern part of county; flows southeasterly 7 miles into Coleto Creek (tributary to Guadalupe River).

TURKEY CREEK.—Erath and Palo Pinto counties; rises north of Shelving Rock near Erath-Eastland County line; flows northerly 7 miles into South Palo Pinto Creek (tributary to Palo Pinto Creek and thus to Brazos River) 2 miles south of Mingus Lake in southwestern part of Palo Pinto County. Stephenville topographic map.

TURKEY CREEK.—Fort Bend County; rises in the southern part; flows southeasterly into Cow Creek and thus to Brazos River.

TURKEY CREEK.—Grimes County; rises in western part of county; flows southwesterly 5 miles from Erwin to its junction with Navasota River (tributary to Brazos River). Navasota topographic map.

TURKEY CREEK.—Harris County; rises 2½ miles southwest of Genoa; flows southeasterly and southwesterly 5 miles into Clear Creek (tributary to Clear Lake, Galveston Bay, and Gulf of Mexico); partially intermittent. Genoa topographic map.

TURKEY CREEK—Harris County; rises 5 miles northeast of Addicks near Katy Cut Off Road; flows southwesterly 5½ miles into Buffalo Bayou (tributary to Sabine, Trinity, and Galveston bays, and thus to Gulf of Mexico); intermittent. Hillendahl topographic map.

TURKEY CREEK.—Hall and Motley counties; rises in southwestern part of Hall County; flows southeasterly 14 miles into Pease River (tributary to Red River and thus to the Mississippi) about 5 miles southwest of Northfield in northern part of Motley County.

TURKEY CREEK.—Hopkins and Rains counties; rises in southwestern part of Hopkins County; flows southerly 10 miles into Lake Fork of Sabine River (tributary to the Sabine) in northeastern part of Rains County.

TURKEY CREEK.—Hunt County; rises near Wolfe City in northern part of county; flows southwesterly 4 miles into South Sulphur River (tributary to Sulphur River, thence through Red River to the Mississippi).

TURKEY CREEK.—Johnson County; rises 1 mile south of Marystown in the northern part of the county; flows southeasterly 11 miles to a point 4 miles southeast of Alvarado in eastern part of the county, where it enters North Fork of Pecan Creek, and thus through Pecan and Richland creeks to Trinty River. Cleburne topographic map.

TURKEY CREEK.—Kinney, Uvalde, and Zavalla counties; rises in the southeastern part of Kinney County; flows southeasterly 7 miles through Kinney County, 15 miles through the southwestern part of Uvalde County, then 32 miles southerly through the western part of Zavalla County into Elm Creek (tributary to the Nueces) near Crystal City. Brackett and Uvalde topographic maps.

TURKEY CREEK.—Montague County; small intermittent stream flowing into [illegible] Creek (tributary to Red River, which discharges into the Mississippi) in the northeastern part of county. Montague topographic map.

TURKEY CREEK.—Palo Pinto and Parker counties; rises two miles north of [illegible] in northwestern corner of Parker County; flows southwesterly 18 miles into Brazos River 3 miles west of Mineral Wells in northeastern corner of Palo Pinto County. Palo Pinto topographic map.

TURKEY CREEK.—Parker County; a small stream flowing into Clear Fork of Trinity River (tributary to West Fork of Trinity River and thus to the Trinity) [illegible] miles southwest of Aledo in southeastern part of county. [illegible] topographic map.

TURKEY CREEK.—Potter County; rises in northeastern corner of Potter County; flows [illegible] miles into Canadian River, thence to the Arkansas, which discharges into the Mississippi.

TURKEY CREEK.—Red River County; small stream about 4 miles southwest of [illegible] flowing into Ward Creek (tributary through Cuthand Creek to Sulphur River and thus through Red River to the Mississippi) in western part of county.

TURKEY CREEK.—San Augustine County; small stream flowing into Ayish Bayou (tributary to Angelina River and thus to the Neches) in central part of county.

TURKEY CREEK.—Tyler County; rises about 4 miles north of Woodville; flows [illegible] miles into Big Cypress Creek (tributary to Alabama Creek and thus to Neches River).

TURKEY CREEK.—Uvalde and Bandera counties; rises about 5 miles southeast of Vanderpool in western part of Bandera County; flows southerly 13 miles into Sabinal River (tributary to Frio River and thus to the Nueces) in northeastern part of Uvalde County.

TURKEY CREEK.—Wilbarger County; rises in south central part; flows southeasterly [illegible] miles into Beaver Creek (tributary to Wichita River and thus through Red River to the Mississippi).

TURKEY CREEK.—Williamson and Milam counties; rises north of Taylor; flows easterly [illegible] miles into Brushy Creek (tributary through San Gabriel River to Little River and thus to the Brazos) 4 miles northeast of Thorndale. Taylor topographic map.

TURKEY CREEK.—Wise County; a small stream flowing into Big Sandy Creek (tributary to West Fork of Trinity River and thus to the Trinity) west of the town of Decatur in central part of county.

TURKEY CREEK.—Wharton County; small intermittent tributary to Pin Oak Creek and thus to Gulf of Mexico through Sandy Creek, Navidad and Lavaca rivers, and Matagorda Bay, in the western part of the county.

TURKEY SPRING BRANCH.—Archer County; headwater stream of West Fork of Trinity River (tributary to the Trinity) in the southeastern part of the county.

TURTLE BAYOU.—Liberty and Chambers counties; rises in Liberty County in the southern part; flows southerly 6 miles through Liberty County, then 6 miles through Chambers County into Turtle Bay (thus to Trinity River, Galveston Bay, and Gulf of Mexico).

TURTLE CREEK.—Dallas County; small tributary to Trinity River northwest of Dallas. Dallas topographic map.

TURTLE CREEK.—Kerr County; rises in the central part of the county; flows easterly 30 miles into Guadalupe River 12 miles south of Kerrville.

TURTLE CREEK.—Matagorda County; rises in the western part of the county; flows southwesterly 6 miles into Turtle Bay, thence to Matagorda Bay and Gulf of Mexico.

TURTLE HOLE CREEK.—Motley County; rises in northeastern part of county; flows easterly 9 miles into Middle Pease River (tributary to Pease River and thus through Red River to the Mississippi).

TURNOVER CREEK.—Coryell County; small stream flowing northeasterly 7 miles into Leon River (tributary to Little River and thus to the Brazos) at Straws Mill in central part of county. Gatesville topographic map.

TUTTLE BRANCH.—Fayette County; southeast of Muldoon in the central part of county; a small intermittent tributary through Pinoak to Buckner Creek, and thus to Colorado River; length, 3 miles. Flatonia topographic map

TUTTLE CREEK—Panola County; northwestern part of county; flows southwesterly 3 miles to its junction with Rogers Creek (thence to Sabine River through Jackson Creek)

TWIN BRANCH.—Leon County; small stream flowing into Upper Keechi Creek (tributary to Trinity River) in northeastern part of the county.

TWIN CREEK.—Van Zandt and Henderson counties; rises in southwestern part of Van Zandt County; flows southwesterly into Cedar Creek (tributary to Trinity River) about 5 miles northwest of Phantom in northwestern part of Henderson County.

TWOMILE CREEK.—Edwards County; a small intermittent stream in southern part of the county; unites with West Nueces River (tributary to Nueces River) just below Ellis; flows easterly 6 miles. Nueces topogrpahic map.

UNION CREEK.—Victoria County; rises near Guadalupe in the central part of the county; flows eastward 12 miles into Lavaca Bay and thus to Matagorda Bay and Gulf of Mexico.

UPPER KEECHI CREEK.—Freestone and Leon counties; rises in central part of Freestone County; flows southeasterly 43 miles into Trinity River in northeastern part of Leon County about 9 miles southeast of Navarro.

UPSHUR CREEK.—Brazos County; the stream flows southeasterly 5 miles from the town of Millican into Navasota River (tributary to Brazos River); intermittent. Navasota topographic map.

VALE CREEK.—Wise County; rises 5 miles south of Boonsville; flows northeasterly 15 miles into West Fork of Trinity River (tributary to Trinity River) about 5 miles southeast of Paradise.

VALENTINE BRANCH.—Tom Green County; southwest of the town of Miles in the northeastern part of the county; an intermittent tributary to Concho River and thus to the Colorado; length, 11 miles. Hayrick topogrophic map.

VALLEY BRANCH.—Ellis and Hill counties; rises 2 miles south of Files Valley; flows northeasterly 6 miles into North Fork of Pecan Creek (tributary to Trinity River through Pecan Creek) in southwestern part of Ellis County. Cleburne topographic map.

VALLEY BRANCH.—Gonzales County; northwest of Nickel in northeastern part of county; small intermittent stream flowing into Peach Creek (tributary to Guadalupe River). Flatonia topographic map.

VALLEY BRANCH.—Johnson County; small stream flowing to Walnut Creek (tributary through Mountain Creek to West Fork of the Trinity River and thus to Trinity River) about 4 miles northwest of Pleasant Point. Fort Worth topographic map.

[illegible]—Montague and Cooke counties; rises about half a mile north [illegible] part of Montague County; flows northeasterly [illegible] tributary to the Mississippi) about 1 mile south of [illegible] northwestern part of Cooke County. Montague [illegible] topographic maps.

[illegible] Wichita counties; rises about 3 miles northeast of [illegible] part of [illegible] County; flows northeasterly 7 [illegible] tributary to Red River and thus to the Missis[illegible] part of Wichita County.

[illegible]—[illegible] County; rises in western part of county; [illegible] into Little Wichita River (tributary to Red [illegible] miles northeast of Henrietta.

[illegible] miles southwest of Marysville in [illegible] miles into Red River (tributary [illegible] northeast of Butcher. Gainesville topo[illegible].

[illegible] Runnels counties; rises 7 miles southeast of Dora [illegible] County; flows southerly 11 miles [illegible] through Runnels County into Colo[illegible] central part of Runnels [illegible] topographic maps.

[illegible] southeast of Pomeantrot; small inter[illegible] of the county; flows into Peach [illegible] topographic map.

[illegible] counties; rises 5 miles south[illegible] of Jeff Davis County; flows southerly [illegible] west of San Carlos. Chispa and San [illegible].

[illegible] southwestern part of county; flows [illegible] River at [illegible].

[illegible] small stream flowing into Bois d'Arc Creek [illegible] into the Mississippi) in the [illegible] of the county.

[illegible] intermittent stream in the western part [illegible] tributary to the Colorado) 4 miles east [illegible] map.

[illegible] small stream flowing into Ash Creek (tribu[illegible] to the Trinity) east of Veal [illegible] Weatherford and Fort [illegible].

[illegible] south of South Prairie; flows [illegible] tributary to Brazos River) 1 mile [illegible] of county. Breckenridge [illegible].

Venado Bayou.—San Augustine County; rises about 5 miles northwest of San Augustine; flows southeasterly 3 miles into Ayish Bayou (tributary to Angelina River and thence to Neches River) about 4 miles south of San Augustine.

Venow Creek.—Kerr County; rises in the southern part of the county; flows northeasterly 14 miles into Guadalupe River at Center Point.

Verde or Lucky Creek.—Bandera and Medina counties; rises in the southeastern part of Bandera County; flows southerly 3 miles through Bandera County, then 20 miles through Medina County into Hondo Creek (tributary [illegible] River through Frio River) near New Fountain.

VICTORIA CANYON.—Culberson County; an intermittent stream in western part of county; flows northeasterly 12 miles into Salt Lake 25 miles north of Van Horn. Van Horn topographic map.

VICTORIA CREEK.—Montague County; rises about 4 miles north of Bowie in western part of county; flows northerly 9 miles into East Belknap Creek (tributary to Belknap Creek and thus through Red River to the Mississippi) 4 miles west of Lucky. Montague topographic map.

VILLAGE CREEK.—Cass County; rises 2 miles south of Hughes Springs in southwestern part of county; flows easterly 4½ miles into Hughes Creek (tributary through Black Cypress and Big Cypress bayous to Ferry Lake, thence to Caddo Lake and thus through Red River to the Mississippi) 3 miles north of Avinger.

VILLAGE CREEK.—Ellis County; rises north of Ennis, in the eastern part of county; flows southeasterly 13 miles into Trinity River in the southeastern part of the county.

VILLAGE CREEK.—Harrison County; rises at Scottsville in eastern part of county; flows northeasterly 18 miles into Caddo Lake (tributary to Red River, and thus to the Mississippi) in the northeastern part of the county.

VILLAGE CREEK.—Montague County; rises about a mile west of Salmon School in northern part of county; flows northeasterly 8½ miles into Red River (tributary to Mississippi River) a mile northeast of Old Spanish Fort; intermittent. Montague topographic map.

VILLAGE CREEK.—Johnson and Tarrant counties; rises about one-half mile east of Joshua in the northern part of Johnson County; flows northeasterly 26 miles into West Fork of Trinity River (tributary to the Trinity) 3 miles northwest of Arlington in Tarrant County. Cleburne and Fort Worth topographic maps.

VILLAGE CREEK.—Van Zandt and Smith counties; rises in the eastern part of Van Zandt County; flows northeasterly 12 miles into Sabine River near Silver Lake near the northwestern corner of Smith County.

VILLAREAL CREEK.—Webb County; a small tributary to Prieto Creek (thence to Nueces River) in eastern part of county.

VINCE BAYOU.—Harris County; a tidal stream; rises in the southeastern part of the county; flows northerly 4 miles into Ship Channel (Buffalo Bayou) and thus to Galveston Bay and Gulf of Mexico 1 mile northwest of Pasadena; historically important as "San Jacinto Battlefield." Deepwater topographic map.

VINCE BAYOU, LITTLE.—Harris County; rises in the southeastern part of county; flows northwesterly 4 miles into Vince Bayou (tributary to Buffalo Bayou and thus to Gulf of Mexico) 1 mile northwest of Pasadena; intermittent. Deepwater topographic map.

VIOLET CREEK.—Kendall County; tributary to Guadalupe River in the central part of the county south of Sisterdale.

WADDELLS CREEK.—Crosby County; rises near Crosby-Dickens County line; flows southwesterly 4 miles into White River (tributary to Salt Fork of Brazos River and thus to the Brazos) in eastern part of county.

WAGON CREEK.—Armstrong County; southern part; flows southeastward 7 miles into Gypsum Creek (tributary to Prairie Dog Town Fork of Red River and thus through Red River to the Mississippi).

WAGON CREEK.—Collingsworth County, Tex., and Beckham County, Okla.; rises in northeastern part of Collingsworth County, Tex.; flows northeastward 1½ miles to its intersection with Texas-Oklahoma boundary line, thence easterly into Elm Fork of Red River (tributary to North Fork of Red River and thus through Red River to the Mississippi).

WAGON TIMBER CREEK.—Young and Stephens counties; rises near Carbondale in southwestern part of Young County; flows southeasterly 5 miles into Clear Fork of Brazos River (tributary to Brazos River) in northern part of Stephens County. Breckenridge topographic map.

WAKEFIELD LAKE.—Gray County; a prairie lake in southwestern part of county; outlet, McClelland Creek (tributary to North Fork of Red River and thus through the Red to Mississippi River); area about 1 square mile.

WALKERS BRANCH.—Tarrant County; small tributary to West Fork of Trinity River (which discharges into the Trinity) south of Smithfield. Fort Worth topographic map.

WALKERS BRANCH.—Ellis County; small stream flowing into Village Creek and thus to Trinity River in southeastern part of county.

WALKER CREEK.—Camp County; rises about 3 miles southwest of Pittsburg; flows northeastward 8 miles to Big Cypress Creek, thence to Caddo Lake and thus through the Red to Mississippi River.

WALKER CREEK.—Comanche and Erath counties; rises near Mount Airy in southwestern part of Erath County; flows southwesterly 5 miles into Leon River (tributary to Little River and thus to the Brazos) 3½ miles southeast of De Leon in northern part of Comanche County. Stephenville topographic map.

WALKER CREEK.—Grimes County; a southerly flowing stream 6 miles long joining Smith Creek and thus through Ben Fort Creek to Navasota River, thence to the Brazos.

WALKER CREEK.—Grimes County; rises east of Wood in southern part of county; flows southwesterly into Brazos River 1½ miles northwest of Courtney. Navasota topographic map.

WALKER CREEK.—Presidio County; an intermittent stream 16 miles long rising in Tierra Vieja Mountains 5 miles southeast of San Carlos and flowing southerly into Capote Creek (tributary to Rio Grande) 4 miles northeast of San Antonio, Mexico. San Carlos topographic map.

WALKER CREEK.—Roberts County; a small intermittent stream 6 miles long flowing southerly into Canadian River (tributary through Arkansas River to the Mississippi) 5 miles northeast of Peaceville in northwestern part of county.

WALLACE BRANCH.—Blanco County; rises in the northeastern part of the county; flows into Cypress Creek, and thus through Pedernales River into the Colorado; length, 3 miles. Blanco topographic map.

WALLACE BRANCH.—Johnson County; a southerly flowing stream 4 miles in length uniting with Nolands River (tributary to the Brazos) 3 miles southeast of Munroe in western part of county. Cleburne topographic map.

WALLACE CREEK.—San Saba County; a stream 15 miles long joining the San Saba (tributary to Colorado River) 4½ miles west of the town of San Saba in the eastern part of the county. San Saba topographic map.

WALLER CREEK.—Cooke County; small intermittent stream flowing into Elm Fork of Trinity River (tributary to the Trinity) west of Muenster in the southwestern part of the county. Gainesville topographic map.

WALLER CREEK.—Travis County; rises north of the city of Austin in the central part of the county; flows southerly 5 miles, passes through the city of Austin into Colorado River one-fourth mile below Congress Avenue viaduct. Austin topographic map.

WALLEYE CREEK.—Milam and Lee counties; rises in southern part of Milam County; flows southerly into Cross Creek (tributary through Second Yegua Creek to Yegua Creek and thus to the Brazos) 1 mile east of Florence; partially intermittent. Bastrop topographic map.

WALOOPE CREEK.—Concho and McCulloch counties; small stream in northwestern part of McCulloch and northeastern part of Concho County; flows through Salt Creek into Colorado River; length, 7 miles. Eden topographic map.

WALNUT CREEK.—Anderson County; rises in the northern part of the county; flows southeasterly 20 miles into Neches River near the International & Great Northern Railway crossing in eastern part of the county.

WALNUT CREEK.—Austin County; rises 2 miles northwest of New Ulm; flows easterly 8 miles into West Fork of Mill Creek (tributary through Mill Creek to Brazos River) 6 miles northeast of New Ulm, in western part of county.

WALNUT CREEK.—Comanche and Erath counties; rises 2 miles southwest of Dublin, in southern part of Erath County; flows southwestward 11 miles into Leon River (which discharges into the Brazos through Little River) 2 miles southwest of Camden. Stephenville and Hamilton topographic maps.

WALNUT CREEK.—Caldwell and Bastrop counties; rises in the northern part of Caldwell County near Lytton Springs; flows easterly 9 miles through Caldwell County, then 19 miles through Bastrop County into Colorado River 1½ miles northwest of Upton. San Marcos, Bastrop, and Flatonia topographic maps.

WALNUT CREEK.—Camp County; rises in northwestern part of county; flows northeasterly 4 miles into Big Cypress Creek, thence to Caddo Lake and thus through Red River to the Mississippi.

WALNUT CREEK.—Donley County; rises in northeastern part of county; flows southeasterly 5 miles into Whitefish Creek (tributary to Salt Fork of Red River and thus through Prairie Dog Town Fork of the Red and Red rivers to the Mississippi).

WALNUT CREEK.—Falls County; an eastward flowing stream 9 miles long joining Brazos River in central part of county east of Lott.

WALNUT CREEK.—Gillespie County; small stream west of Cherry Spring, in northern part of county; flows northward 6 miles into Beaver Creek (tributary through Llano River to the Colorado). Kerrville topographic map.

WALNUT CREEK.—Grayson County; rises at Red Branch, in northwestern part of county; flows easterly 5 miles into Mineral Creek (tributary to Red River and thus to the Mississippi) about a mile south of Cedar Mills. Denison topographic map.

WALNUT CREEK.— Grimes, Waller, and Montgomery counties; rises in southeastern part of Grimes County; flows southeasterly 4 miles through Grimes, 8 miles through Waller, then 8 miles through Montgomery County into Spring Creek (tributary to West San Jacinto River, San Jacinto River, and Gulf of Mexico).

WALNUT CREEK.—Hood County; small stream flowing southerly 7 miles into Brazos River, 2 miles south of Acton, in northeastern part of county. Granbury topographic map.

WALNUT CREEK OR ROSE BAYOU.—Houston County; flows northeasterly 14 miles into Neches River in the eastern part of the county.

WALNUT CREEK.—Jasper County; rises about 2 miles east of Jasper; flows southwesterly 16 miles into Neches River.

WALNUT CREEK.—Johnson, Tarrant, and Dallas counties; rises about 3 miles northwest of Alvarado, in Johnson County; flows northeasterly 24 miles into Mountain Creek (which discharges into Trinity River through West Fork of the Trinity) 4 miles northwest of Cedar Hill, in Dallas County. Cleburne, Fort Worth, and Dallas topographic maps.

WALNUT CREEK.—Kaufman County; joins Ferris Fork of Cedar Creek (tributary to Cedar Creek and Trinity River) in southeastern part of county.

WALNUT CREEK.—Llano and Blanco counties; rises in the northern part of Blanco County; flows northward 11 miles into Sandy Creek (tributary to the Colorado) 1½ miles south of Sandy Mountain, Llano County. Burnet and Blanco topographic maps.

WALNUT CREEK.—Motley County; rises about 4½ miles east of Lyman, in southwestern part of county; flows southeastward 13 miles to its confluence with Oliver Fork of South Pease River to form South Pease River (tributary through Middle Pease River to Pease River and thus through the Red to Mississippi River) about 4 miles southeast of Roaring Springs; headwater stream of South Pease River.

WALNUT CREEK.—Orange County; small stream joining Neches River in the northwestern part of the county southeast of Fletcher.

WALNUT CREEK.—Palo Pinto County; a stream 4 miles long flowing southeasterly into Middle Creek (tributary to Palo Pinto Creek and thus to Brazos River) in southern part of county 2 miles northeast of Strawn. Palo Pinto topographic map.

WALNUT CREEK.—Roberts County; rises in southwestern part of county; flows northerly 19 miles to Canadian River (tributary to Arkansas River and thus to the Mississippi) 7 miles northeast of Peaceville, in northwestern part of county.

WALNUT CREEK.—Robertson County; rises in northern part of county; flows southwestward 15 miles into Little Brazos (tributary to Brazos River) 3 miles northwest of Calvert.

WALNUT CREEK.—Sabine County; rises in southern part of county; small headwater tream of Sixmile Creek (tributary to Sabine River).

WALNUT CREEK.—Travis County; rises just south of Merrilltown in the northern part of the county; flows southerly 14 miles into Colorado River, 2 miles southeast of Fort Prairie in the central part of the county. Austin topographic map.

WALNUT CREEK.—Upshur County; rises about 4 miles south of Coffeeville in eastern part of county; flows southerly 9 miles into Little Cypress Creek (tributary through Caddo Lake to Red River and thus to the Mississippi) near Jameson.

WALNUT CREEK.—Waller County; small stream rising 5 miles west of Howth in the northwestern part of the county and flowing southerly 5 miles into Brazos River, 4 miles west of Hempstead. Howth topographic map.

WALNUT CREEK.—Wise County; a small tributary to West Fork of Trinity River (which discharges into the Trinity) in the southeastern part of the county.

WALNUT CREEK.—Washington County; rises 3 miles northwest of Burton; flows southeasterly 9 miles into East Fork of Mill Creek (tributary to Mill Creek and thus to the Brazos) 7 miles west of Brenham in western part of county.

WALNUT CREEK.—Wise, Parker, and Tarrant counties; rises at Agnes in the northern part of Parker County; flows easterly 20 miles into West Fork of Trinity River (tributary to the Trinity) about 3 miles east of Azle in Tarrant County. Weatherford and Fort Worth topographic maps.

WANDERER CREEK.—Hardeman and Wilbarger counties; rises about 6 miles southwest of Quanah in the central part of Hardeman County; flows northeasterly 31 miles into Prairie Dog Town Fork of Red River (tributary to Red River, which discharges into the Mississippi) in northwestern part of Wilbarger County.

Ward Spring Branch.—Bowie County; about 5 miles southeast of New Boston; small tributary to Rock Creek (which discharges through Langum Creek into Sulphur River and thus through Red River to the Mississippi).

Ward or Wagner Creek.—Bowie County; rises about 7 miles northwest of Texarkana; flows southeasterly 8 miles to its junction with Harris Creek about 1½ miles south of Texarkana to form Hurricane Creek (tributary to Sulphur River and thus through Red River to the Mississippi) in the eastern part of the county. Texarkana topographic map.

Ward Creek.—Bowie County; rises about 5 miles south of DeKalb; flows southwesterly 7 miles into Ross Creek (tributary through Bassett Creek to Sulphur River and thus through Red River to the Mississippi) about 3½ miles northwest of Bassett in western part of counuty.

Ward Creek.—Hopkins County; small tributary to Garrett Creek (thence to Lake Fork of Sabine and Sabine rivers) in southwestern part of county.

Ward Creek.—Lamar and Red River counties; rises about a mile east of Blossom in the eastern part of Lamar County; flows southeasterly 16 miles into Cuthand Creek (tributary to Sulphur River and thus through Red River to the Mississippi) about 9½ miles southwest of Bagwell in western part of Red River County.

Wards Creek.—Medina County; flows southeasterly 6 miles to its junction with Hondo River (thence to Nueces River through Frio River) in the northern part of the county.

Warden Creek.—Anderson County; small stream 5 miles long flowing southeasterly into Ioni Creek (tributary to Neches River) in southeastern part of county.

Warley Lake.—Donley County; about a mile southeast of Lelia; an expansion of Lake Creek (tributary to Salt Fork of Red River, thence to Prairie Dog Town Fork of the Red River and thus through Red River to the Mississippi).

Warren Creek.—King County; a small stream rising in northeastern part of county and flowing into Polecat Creek (tributary through Farrers Creek to Middle Fork of Wichita River and thus through North Wichita River and Red River to the Mississippi).

Warring Creek.—Hamilton County; rises 5 miles northeast of Pottsville near Hamilton-Comanche county line; flows northeasterly 14 miles into Leon River (tributary to Little River and thus to the Brazos) 3½ miles northeast of Gentry Mill. Hamilton topographic map.

Wash Branch.—Palo Pinto County; a small stream flowing easterly 2 miles into Brazos River at Red Bluff in eastern part of county. Palo Pinto topographic map.

Washita River.—Roberts and Hemphill counties; rises near Miami in southeastern part of Roberts County; flows easterly about 35 miles to its intersection of the Texas-Oklahoma boundary line 5 miles southeast of Gem in southeastern part of Hemphill County; thence takes a southeasterly course to its junction with Red River (tributary to the Mississippi) in southern part of Oklahoma 10 miles northwest of Denison, Tex.

Washboard Canyon.—Brewster and Terrell counties; rises in southwestern part of Terrell County; flows southeasterly 12 miles, crossing Brewster-Terrell County line into San Francisco Creek (tributary to Rio Grande) near junction of Brewster-Terrell County line with Rio Grande; intermittent. Indian Wells topographic map.

Washboard Creek.—Mills and Hamilton counties; rises in northern part of Mills County; flows northeasterly 6 miles into Cowhouse Creek (tributary through Leon to Little River and thus to the Brazos) 3 miles northwest of Indian Gap. Brownwood and Hamilton topographic maps.

WASP CREEK.—Kendall County; rises near Welfare in central part of county; flows into Guadalupe River.

WATER OR SWEETWATER CREEK.—Gray and Wheeler counties, Tex., and Roger Mills and Beckham counties, Okla.; rises in northeastern corner of Gray County, Tex.; flows eastward 40 miles to its intersection with the Texas-Oklahoma boundary line on east boundary of Wheeler County, then southerly through Roger Mills and Beckham counties, Okla., into North Fork of Red River (tributary to Red River and thus to the Mississippi).

WATERS CREEK.—Llano County; an intermittent stream flowing into Llano River (tributary to the Colorado) 4 miles northwest of Packsaddle in the eastern part of the county; length, 5 miles. Llano topographic map.

WATERHOLE BRANCH.—Bastrop County; a small stream 4 miles in length in south central part of county; flowing through Sandy Creek into Walnut Creek thence to Colorado River. Flatonia topographic map.

WATERHOLE CREEK.—Colorado County; rises in the western part of the county; flows southwesterly 4 miles into Navidad River (tributary to Lavaca River, Matagorda Bay, and Gulf of Mexico).

WATERHOLE CREEK.—Colorado County; rises 5 miles south of Weimar; flows southwestward 7 miles into Navidad River (tributary to Lavaca River thence to Matagorda Bay and Gulf of Mexico) near Colorado-Lavaca County line.

WATSONS CREEK.—Throckmorton County; small stream rising in northeast corner of county; flows southerly 2½ miles into Brazos River.

WATTO CREEK.—Sabine County; small stream flowing easterly 5 miles into Housing Bayou (tributary to Sabine River) in central part of county.

WATTS CREEK.—Coleman County; an intermittent stream north of Santa Anna in the eastern part of the county; flows into Jim Ned Creek (tributary through Pecan Bayou to the Colorado); length, 9 miles. Coleman topographic map.

WAXAHACHIE CREEK.—Ellis County; formed about 3 miles southeast of Waxahachie by the union of the North and South Forks of Waxahachie Creek; flows southeasterly 14 miles into Pecan Creek (tributary through Richland Creek to Trinity River) near its intersection with the south line of county.

WAXAHACHIE CREEK, NORTH FORK OF.—Ellis County; rises in the northwestern part of the county; flows southeasterly 15 miles to its junction with the South Fork of Waxahachie Creek forming Waxahachie Creek (tributary to Pecan and Richland creeks, thence to Trinity River) 3 miles southeast of the town of Waxahachie.

WAXAHACHIE CREEK, SOUTH FORK OF.—Ellis County; rises in northwestern part of county; flows southeasterly 12 miles to its confluence with North Fork of Waxahachie Creek forming Waxahachie Creek (tributary to Pecan and Richland creeks; thence to the Trinity) about 3 miles southeast of the town of Waxahachie.

WEADINGTON CREEK.—Stonewall County; a stream 8 miles long flowing easterly into Croton Creek (tributary to Brazos River) 3 miles northwest of Kiowa Peak in northeastern part of county.

WEAKLEY BRANCH.—Ellis County; small stream flowing through southwestern part of county to a point east of Files Valley, where it enters North Fork of Pecan Creek (tributary to Pecan and Richland creeks and Trinity River). Cleburne topographic map.

WEBSTER CREEK.—Cass County; rises about 1½ miles southeast of Douglasville in northern part of county; flows northeasterly 4 miles into Shoal Creek (tributary to Sulphur River, which discharges into the Mississippi through Red River). Linden topographic map.

WEIRS CREEK.—Montgomery County; a small tributary to West San Jacinto River (thence to Gulf of Mexico through San Jacinto River and Galveston Bay) in the northern part of the county; flows southwesterly 5 miles.

WELCHS BAYOU.—Falls and Robertson counties; rises 2 miles northwest of Reagan in eastern part of Falls County; flows southerly 14 miles into Brazos River 4½ miles west of Hammond in western part of Robertson County.

WELCH CREEK.—Concho County; an intermittent stream 3 miles long in the western part of the county; flows into Kickapoo Creek (tributary to Concho River and thus to the Colorado). San Angelo topographic map.

WELLS CREEK.—Anderson County; rises about 2 miles north of Palestine; flows northeasterly 7 miles into Hurricane Creek, thence to Neches River.

WEST ALAMOSA CREEK.—Oldham County; an intermittent stream rising 13 miles southwest of Cheyenne and flowing northerly 7 miles to a point 6 miles southwest of Cheyenne where it unites with Middle Alamosa Creek (tributary through Canadian River to the Arkansas and thus to the Mississippi) in northwestern part of county.

WEST BELKNAP CREEK.—Clay and Montague counties; rises southeast of Bellevue in southeastern part of Clay County; flows northeasterly 12 miles to its confluence with Middle Belknap Creek to form Belknap Creek (tributary to Red River and thus to the Mississippi) 4 miles northwest of Stoneburg, in the western part of Montague County. Montague topographic map.

WEST BERNARD RIVER.—Wharton County; rises in the northeastern part of the county; flows southeasterly 19 miles into San Bernard River and thus to Gulf of Mexico.

WEST BITTER CREEK.—Donley and Hall counties; rises in southern part of Donley County; flows southeasterly 4 miles into Bitter Creek (tributary to Mulberry Creek, thence to Prairie Dog Town Fork of Red River and thus through the Red to Mississippi River) in northwestern part of Hall County.

WEST BROOK CREEK.—Fayette County; northwest of Flatonia in southwestern part of the county; small intermittent stream flowing into Big Fivemile Creek (thence to Peach Creek and Guadalupe River). Flatonia topographic map.

WEST BRUSHY CREEK.—Delta County; rises about 4 miles east of Cooper; flows southeasterly 8 miles to its junction with East Brushy Creek forming Brushy Creek (tributary to South Sulphur River, thence through Sulphur River to Red River and thus to the Mississippi).

WEST BUFFALO CREEK.—Johnson County; rises at Brushy Knob in central part of county; flows southerly 9 miles to its junction with East Buffalo Creek forming Buffalo Creek (tributary through Nolands River to the Brazos) 1 mile south of the town of Cleburne. Cleburne topographic map.

WEST BUFFALO CREEK.—Cottle County; rises in southeastern part of county; flows northward 6 miles into North Wichita River (tributary to Wichita River and thus through Red River to the Mississippi).

WEST BULL CREEK.—Travis County; a small tributary through Bull Creek to Colorado River in the north central part of the county; length, 4 miles. Austin topographic map.

WEST CARANCAHUA CREEK.—Jackson County; a small stream in the eastern part of the county; flows southerly to its junction with Carancahua Creek (and thus to Matagorda Bay and Gulf of Mexico) about 2 miles north of Carancahua Bay.

West Copperas Creek.—Sutton and Kimble counties; a stream 5 miles long flowing through the northwestern part of Kimble County and eastern part of Sutton County to its junction with Copperas Creek and thus through North Llano River to Llano River (tributary to the Colorado). Fort McKavett topographic map.

West Farmers Creek.—Montague County; rises about 3 miles east of Montague in central part of county; flows northerly 8 miles into Farmers Creek (tributary to Red River and thus to the Mississippi) about 2 miles west of [illegible]. Montague topographic map.

West Kickapoo Creek.—[illegible] and Runnels counties; an intermittent stream in the northeastern part of [illegible] County and western part of Runnels County; flows 11 miles into Kickapoo Creek and then to the Colorado. Runnels topographic map.

West Little Postoak Creek.—Archer County; rises about 10 miles southeast of Archer City in eastern part of county; flows northeastward 10 miles to its junction with East Little Postoak Creek (tributary to Postoak Creek, Little Wichita River, and thus through Red River to the Mississippi) 11 miles northeast of Archer City.

West Noland Creek.—Johnson County; rises 2½ miles southwest of Bruce in western part of county; flows southeasterly 6 miles to its junction with Middle Noland Creek to form Nolands River (tributary to Brazos River) 2 miles southeast of [illegible]. Granbury and Cleburne topographic maps.

West Prong.—Lavaca County; rises southwest of Moulton; flows northeasterly and southeasterly 6 miles to its junction with Lavaca River (thence to Gulf of Mexico through Matagorda Bay) about 2½ miles southeast of Moulton. Flatonia topographic map.

West Salt or [illegible] Creek.—Collingsworth, Hall, and Childress counties; rises in southwestern part of Collingsworth County; flows southeasterly 16 miles into Salt Creek (tributary to Prairie Dog Town Fork of Red River and thus through Red River to the Mississippi) in northern part of Childress County.

West San Jacinto River.—Walker, Montgomery, and Harris counties; rises in southwestern part of Walker County; flows southeasterly about 70 miles through Harris and Montgomery counties to its junction with East San Jacinto River, in the northeastern corner of Harris County, to form San Jacinto River, tributary to Galveston Bay and thus to Gulf of Mexico.

West Sandy Creek.—Walker County; small tributary to West San Jacinto River (tributary to San Jacinto River and Gulf of Mexico) in the southwestern part of the county; flows southeasterly.

West State Line Creek.—Cass County; rises about 2 miles southeast of Queen City in northeastern part of county; flows southeasterly 8 miles into State Line Creek (tributary to Caddo Lake and thus through Red River to the Mississippi) near the Texas-Arkansas boundary line, about one-half mile southwest of Ravana, Ark.

West Valley Branch.—Montague County; small intermittent stream; unites with Valley Branch (tributary to Red and Mississippi rivers) in extreme northeastern part of county. Montague topographic map.

Wheat Creek.—Bell County; small stream flowing into Little River (tributary to the Brazos) in southern part of county north of Holland; length, 9 miles. Taylor topographic map.

Wheat Creek.—Cooke County; an intermittent tributary to Clear Creek (which discharges into Elm Fork of Trinity River, thence to the Trinity) southwest of Hood. Gainesville topographic map.

WHEELER CREEK.—Cooke County; joins Pecan Creek (which discharges into Trinity River through the Elm Fork of the Trinity) east of the town of Gainesville. Gainesville topographic map.

WHEELOCK CREEK.—Leon County; small stream, 6 miles long, rising in northeastern part of county and flowing northeasterly into Buffalo Creek, thence to Upper Keechi Creek and Trinity River.

WHITE CREEK.—Lampasas County; rises near Coryell-Lampasas county line; flows southwesterly 4½ miles into Lampasas River (tributary through Little River to the Brazos) 2 miles northwest of Townsen Mills. Lampasas topographic map.

WHITE CANYON.—Fisher County; small intermittent branch of Double Mountain Fork of Brazos River rising 8 miles northwest of Fisher and flowing northeasterly 5 miles. Roby topographic map.

WHITE CREEK.—Llano County; tributary through Sandy Creek to Colorado River in the southeastern part of the county; length, 10 miles. Fredericksburg, Llano, and Burnet topographic maps.

WHITES BAYOU.—Chambers County; a small tidal stream in the northern part of county; flows southwesterly 3 miles into Turtle Bay and thus through Trinity to Galveston Bay and Gulf of Mexico.

WHITES CREEK.—Brazos County; small southerly flowing stream 3 miles long joining Brazos River west of Welburn.

WHITE ROCK CREEK.—Collin and Dallas counties; rises about 3 miles northeast of Frisco in Collin County; flows southerly 33 miles into Trinity River 1 mile west of Miller. Dallas topographic map.

WHITE OR BLANCO FORK OF BRAZOS RIVER.—Kent, Garza, Crosby, Floyd, Hale, and Castro counties; rises south of Dimmitt in south central part of Castro County; flows southeasterly 130 miles into Salt Fork of Brazos River (tributary to the Brazos) in northwestern part of Kent County, principal tributary to Salt Fork of Brazos River.

WHITE BLUFF CREEK.—Somervell County; an intermittent stream rising 3 miles northeast of Chalk Mountain and flowing northerly 5 miles into Paluxy Creek (tributary to Brazos River) 4 miles west of Glenrose in western part of county. Granbury topographic map.

WHITE DEER CREEK.—Hutchinson and Carson counties; rises 8 miles north of White Deer in northeastern part of Carson County; flows northerly into Canadian River (tributary to Arkansas River and thus to the Mississippi) 10 miles northeast of Plemons in eastern part of Hutchinson County; length, 24 miles.

WHITE FISH CREEK.—Gray and Donley counties; rises in southern part of Gray County; flows southeasterly 22 miles into Salt Fork of Red River (tributary to Prairie Dog Town Fork of the Red and thus through Red River to the Mississippi) in eastern part of Donley County.

WHITEOAK BAYOU.—Harris County; rises near Fairbanks in northwestern part of the county; flows southeasterly 21 miles into Buffalo Bayou (thence to Galveston Bay and Gulf of Mexico) in the City of Houston. Satsuma, Hillendahl, Aldine, and Houston Heights topographic maps.

WHITEOAK CREEK OR BAYOU.—Hopkins, Franklin, Titus, and Morris counties; rises in central part of Hopkins County near Sulphur Springs; flows easterly through northern part of Franklin, Titus, and Morris counties into Sulphur River (tributary to Red River, which discharges into the Mississippi) 5 miles north of Naples in northeastern part of Morris County; length, 65 miles.

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[illegible]

[illegible] Johnson City [illegible]

[illegible]

[illegible] Fork of [illegible] River [illegible]

[illegible] Pedernales River [illegible]

[illegible]

[illegible]

[illegible] River in western [illegible]

[illegible] southeastern part [illegible] miles through Montgomery [illegible] Gulf of Mexico [illegible]

[illegible] miles southwest of [illegible] Big Cow Creek [illegible] tributary to Sabine [illegible]

[illegible] small tributary in northern part of [illegible] tributary to [illegible]

[illegible] Creek.—Red River County: rises [illegible] of [illegible] in [illegible] miles into Kickapoo Creek [illegible] Creek and [illegible] through Sulphur and Red rivers [illegible]

[illegible] Creek.—[illegible] County: rises about [illegible] then [illegible] Trinity River [illegible] miles southeast of the town of [illegible] 22 miles.

[illegible] Creek.—Hill County: small tributary to Pecan Creek (which discharges into Trinity River through Richland Creek) in eastern part of county. Corsicana topographic map.

White Rock Creek.—Hill County: rises 4 miles southeast of Whitney in [illegible] part of county; flows southerly 6 miles into Brazos River. Waco topographic map.

White Rock Creek.—McLennan County: rises about 4 miles north of Ross; flows southerly 12 miles into Brazos River 3½ miles north of Waco near central part of county. Waco topographic map.

Whitesmith Creek.—Motley County: a small stream flowing through northwestern part of county to Quitaque Creek (tributary to Pease River, which discharges into the Mississippi through Red River).

Wichita or Big Wichita River.—Baylor, Archer, Wichita, and Clay counties; formed northwest of Seymour in northwestern part of Baylor County by union of North and South Wichita rivers; flows northeastward about 90 miles into Red River (tributary to the Mississippi) about 3 miles northwest of Byers in northern part of Clay County. Fowlkes, Iowa Park, and West Wichita Falls topographic maps.

Wicksons Creek.—Brazos County; rises near Tabor in northwestern part of county; flows southeasterly 10 miles into Brushy Creek (tributary through Navasota River to the Brazos).

Wiesache (Huisache) Creek.—Jackson and Calhoun counties; rises in the southeastern part of Jackson County; flows southerly and southeasterly 11 miles through Jackson County, then 5 miles through Calhoun County into Cow Bay, thence to Lavaca Bay and Gulf of Mexico.

Wilbarger Creek.—San Saba County; a partially intermittent stream rising 3½ miles northeast of Cowboy in the northeastern part of the county and flowing 14 miles into Colorado River. Brady and San Saba topographic maps.

Wilbarger Creek.—Travis and Bastrop counties; rises in the eastern part of Travis County; flows southeasterly 14 miles through Travis County, then 14 miles through Bastrop County into Colorado River 6 miles northwest of Bastrop in the central part of Bastrop County. Austin and Bastrop topographic maps.

Wilburn Branch.—Cooke County; small stream flowing about a mile west of Marysville in northern part of county and entering South Fish Creek (tributary to Fish Creek, thence to Red and Mississippi rivers). Gainesville topographic map.

Wild Cat Creek.—Cooke County; small intermittent stream flowing into Elm Fork of Trinity River (tributary to the Trinity) about 3 miles southwest of Myra. Gainesville topographic map.

Wild Cat Creek.—Coleman County; a stream 4 miles long; flows to the southwest of the town of Coleman in the central part of the county; joins Colorado River through Home Creek. Coleman topographic map.

Wild Cat Creek.—Hall County; a stream 4 miles long rising in western part of county and flowing southeasterly into Little Red River (tributary through Prairie Dog Town Fork of Red River to the Red and thus to the Mississippi).

Wild Cat Creek.—Henderson and Anderson counties; rises in southwestern part of Henderson County; flows southwesterly 11 miles into Trinity River near northwestern corner of Anderson County.

Wild Cat Creek.—Wilbarger County; rises in northwestern part of county; flows southerly 7 miles into Pease River (tributary to Red River and thus to the Mississippi) about 2 miles northwest of Vernon.

Wild Cat Creek.—Red River County; rises about 3 miles northwest of Detroit near Lamar-Red River county line; flows southeasterly 10 miles into Ward Creek (tributary to Cuthand Creek and thus through Sulphur and Red rivers to the Mississippi) in western part of county.

Wild Horse Creek.—Jeff Davis and Culberson counties; rises 3 miles southwest of Chispa in eastern part of Jeff Davis County; flows northerly 40 miles to a point in southern part of Culberson County 10 miles north of Wild Horse, where it sinks in sands; intermittent. Chispa and Van Horn topographic maps.

Wild Horse Creek.—Wichita County; rises in northern part of county 1¾ miles southwest of Clara; flows northeastward 6 miles into Red River (tributary to Mississippi). Clara topographic map.

W[illegible] Creek.—[illegible] County; rises near W[illegible]; flows northerly 10 miles [illegible] tributary to Canadian River and thus [illegible] Mississippi near Oldham-Potter county line.

W[illegible] Creek.—[illegible] County; rises about 5 miles east of Gary; flows [illegible] into [illegible] River about 5 miles southwest of Logan.

[illegible] Creek.—[illegible] County; rises 4 miles northwest of Lanark; flows northwesterly 3 miles into [illegible] River (tributary to Red River, which discharges into the Mississippi). [illegible] topographic map.

W[illegible] Creek.—[illegible] and [illegible] counties; rises about one-half mile [illegible]; flows southeasterly 12 miles into Clear Creek (tributary to Elm Fork of Trinity River and thus to the Trinity) 7 miles [illegible] in the southwestern part of the county. Montague and [illegible] topographic maps.

W[illegible] Creek.—[illegible] County; rises in the northwestern part of county; flows southeasterly and easterly 1[illegible] miles into Salt Fork of Red River (tributary to Prairie Dog Town Fork of the Red and thus through Red River to the Mississippi) in the western part of county.

Williams Creek.—Bandera County; a small intermittent stream in southern part of the county; flows southeasterly 6 miles to its junction with Hondo River (thence to the Nueces through Frio River) near southern county line.

Williams Creek.—Cooke County; an intermittent stream flowing into Clear Creek (tributary to Elm Fork of Trinity River, then to Trinity River) in southwestern part of the county. Gainesville topographic map.

Williams Creek.—Fayette County; rises in southeastern part of county 4 miles south of La Grange; flows southeastward to its junction with Colorado River; length, 8 miles.

Williams Creek.—Gillespie and Blanco counties; flows into Pedernales River (tributary to Colorado River) 2 miles southwest of Westbrook in the western part of Blanco County; length, 6 miles. Fredericksburg topographic map.

Williams Creek.—Jasper County; small stream flowing into Jordan Creek (tributary to Indian Creek, thence to Angelina and Neches rivers) in northwestern part of the county.

Williams Creek.—Jack County; small stream flowing into North Creek (tributary to West Fork of Trinity River and thus to the Trinity) northwest of Jacksboro in central part of the county.

Williams Gully.—Harris County; rises 4 miles southeast of Humble; flows southwesterly 4½ miles into Garner Bayou (thence to Greens Bayou, and thus through Buffalo Bayou to Gulf of Mexico); intermittent. Harmaston topographic map.

Williams Creek.—Lavaca and Dewitt counties; a small stream 3 miles long flowing southeastward along county line into Little Brushy Creek (which discharges into Lavaca River through Chicolete Creek and thus to Matagorda Bay and Gulf of Mexico).

Williamson Creek.—Travis County; rises 3 miles northwest of Oak Hill, in the southwestern part of the county; flows southeastward 14 miles into Onion Creek and thus to Colorado River, 4 miles southwest of Delvalle; intermittent. Austin topographic map.

Williamson Creek.—Williamson County; rises at Corn Hill; flows southeasterly 20 miles into San Gabriel River (tributary through Little River to the Brazos) 8 miles southeast of Granger. Taylor and Georgetown topographic maps.

WILLIES CREEK.—Howard, Borden, Scurry, and Mitchell counties; rises in northern part of Howard County; flows in a northeasterly and easterly direction 23 miles into Colorado River in the northwestern part of Mitchell County.

WILLIS CREEK.—Brown County; rises south of Brownwood in the southeastern part of the county; flows 7 miles into Pecan Bayou (tributary to the Colorado). Coleman and Brownwood topographic maps.

WILLOW BAYOU.—Galveston County; rises in the western part of the county; flows southwesterly 3 miles into Halls Bayou, thence to West Galveston Bay and Gulf of Mexico.

WILLOUGHBY BRANCH.—Mills County; rises in northwestern part of county, 2¼ miles northwest of Mullen; flows westerly 4 miles into Pompey Creek (tributary to Pecan Bayou and thus to Colorado River and Gulf of Mexico); partially intermittent. Brownwood topographic map.

WILLOW BRANCH.—Colorado County; rises in the northeastern part of the county; flows southeasterly 8 miles into San Barnard River (thence to Gulf of Mexico).

WILLOW BRANCH.—Lavaca County; in eastern part of county; flows southwesterly 5 miles into Navidad River (tributary to Lavaca River, Matagorda Bay, and Gulf of Mexico), 6 miles south of Sublime.

WILLOW BRANCH.—Tarrant County; small stream joining Walnut Creek (tributary through Mountain Creek to West Fork of Trinity River, and thus to the Trinity) west of the town of Mansfield. Fort Worth topographic map.

WILLOW CREEK.—Aransas County; rises in the northern part of the county; flows southward 3 miles into St. Charles Bay and thus to Aransas Bay and Gulf or Mexico.

WILLOW CREEK.—Bastrop County; small intermittent stream 7 miles in length flowing into Colorado River 3 miles northeast of Smithville in the southeastern part of the county. Bastrop and Flatonia topographic maps.

WILLOW CREEK.—Bosque County; rises 4 miles west of Merrivale in southern part of the county; flows southeasterly 8 miles into Childress Creek (tributary to Brazos River). Waco topographic map.

WILLOW CREEK.—Brewster County; an intermittent stream in southern part of county flowing southerly 10 miles into Rio Grande 5 miles southeast of Terlingua Abaja. Terlingua and Chisos Mountains topographic maps.

WILLOW CREEK.—Cooke County; small intermittent stream joining Spring Creek (which discharges into Elm Fork of Trinity River, and thus to the Trinity) south of Gainesville in the southern part of the county. Gainesville topographic map.

WILLOW CREEK.—Cottle County; small stream rising in southeastern part of county and flowing into North Wichita River (tributary to Wichita River and thus through Red River to the Mississippi).

WILLOW CREEK.—Gillespie County; rises about 5 miles northwest of Willow in the northeastern part of the county; flows southeasterly 12 miles into North Grape Creek (tributary through Pedernales River to the Colorado). Fredericksburg topographic map.

WILLOW CREEK.—Jack and Wise counties; joins Gentry Creek (tributary to West Fork of Trinity River and thus to the Trinity) in the southeastern part of Jack and southwestern part of Wise County.

WILLOW CREEK.—King County; rises in the northwestern part of the county; flows southeasterly 21 miles into South Wichita River (tributary through Wichita River to Red River and thus to the Mississippi) about 7 miles east of Guthrie in central part of county.

Willow Creek.—Harris County; rises in northwestern part 2½ miles southwest of Rose Hill School; flows easterly 17 miles into Spring Creek (tributary to San Jacinto River, Galveston Bay, and Gulf of Mexico); partially intermittent. Rose Hill, Louetta, and Spring topographic maps.

Willow Creek.—Lee County; a small intermittent stream flowing southeasterly 5 miles into Second Yegua Creek (tributary through Yegua Creek to Brazos River) south of Lexington. Bastrop topographic map.

Willow Creek.—Llano County; a stream 7 miles long flowing into Sandy Creek (tributary to Colorado River) 2 miles west of Lone Mountain, in the southern part of the county. Llano topographic map.

Willow Creek.—Llano County; an intermittent stream flowing into Johnson Creek (tributary through Llano River to the Colorado) northwest of the town of Llano in the northern part of the county; length, 9 miles. Llano topographic map.

Willow Creek.—Lipscomb County; an intermittent stream flowing northerly 7 miles into Wolf Creek (tributary through North Fork of Canadian River to the Canadian and thus through Arkansas River to the Mississippi) 6 miles east of Lipscomb in eastern part of county.

Willow Creek.—Mason County; rises 5 miles west of Fly Gap in the eastern part of the county; flows southeasterly 14 miles into Llano River (tributary to the Colorado) 3 miles east of Hedwigs Hill. Mason topographic map.

Willow Creek.—Maverick County; formed by the union of two streams, not named on map, rising near central part of county and flowing southward 8 miles; flows southerly 18 miles into Rio Grande 16 miles southeast of the town of Eagle Pass in soutern part of county.

Willow Creek.—McMullen and La Salle counties; rises in the eastern part of La Salle County; flows northeasterly 3 miles through La Salle County, then 6 miles through McMullen County into Frio River (tributary to the Nueces); length, 9 miles.

Willow Creek.—McLennan County; rises at McGregor; flows easterly 6 miles into South Bosque River (tributary to Bosque River and thus to the Brazos) in the southwestern part of county. Temple topographic map.

Willow Creek.—Parker County; rises approximately 1 mile north of Peister; flows southeasterly 13 miles into South Fork of Trinity River (tributary through Clear Fork of Trinity River to the West Fork of Trinity River and thus to Trinity River) about 4 miles southeast of Weatherford. Weatherford topographic map.

Willow Creek.—Roberts and Hutchinson counties; rises near Ochiltree-Roberts county line; flows southerly into Canadian River (which discharges into the Mississippi through Arkansas River) 4 miles northwest of Peaceville in northeastern part of Hutchinson County.

Willow Creek.—Runnels and Tom Green counties; tributary to Concho River (and thus to the Colorado) in the northeastern part of Tom Green County and southwestern part of Runnels County west of Miles; length, 13 miles. Hayrick topographic map.

Willow Creek.—Travis County; eastern part of the county; tributary through Elm and Wilbarger creeks to Colorado River; length, 11 miles. Bastrop topographic map.

Willow Creek.—Wilson County; rises in northeastern part of county; small tributary to Elm Fork of Sandies Creek (tributary to Sandies Creek, and thus to Guadalupe River).

WILLOWOAK CREEK.—Fannin and Hunt counties; rises in southeastern part of Fannin County near the southern boundary; flows southeasterly 11 miles into Middle Fork of Sulphur River (tributary to South Sulphur River, and thus through Sulphur and Red rivers to the Mississippi) in the northeastern part of Hunt County.

WILLOW MARSH.—Jefferson County; rises near Meeker in the northern part of the county; flows southeasterly 12 miles into Hillebrant Bayou (tributary to Taylors Bayou, and thus to Sabine Lake and Gulf of Mexico) 5 miles east of Cheek.

WILLOW MARSH.—Liberty and Jefferson counties; an intermittent slough; heads in eastern part of Liberty County; terminates in Pine Island Bayou (tributary to Neches River) in northwestern part of Jefferson County; length, about 25 miles.

WILLOW SPRINGS.—Donley County; small stream flowing through northeastern part of county into Whitefish Creek (tributary to Salt Fork of Red River, and thus through Prairie Dog Town Fork of Red River to the Red and Mississippi rivers).

WILLOW WATER HOLE BAYOU.—Harris County; rises in the southern part of the county; flows northeasterly 5 miles into Brays Bayou, thence to Ship Channel, Galveston Bay, and Gulf of Mexico. Alief and Bellaire topographic maps.

WILLOUGHBY BRANCH.—Mills County; small tributary in the northwestern part of the county; flows into Pompey Creek (tributary to Blanket Creek, and thus through Pecan Bayou to Colorado River) northwest of Mullen; length, 4 miles. Brownwood topographic map.

WILSON BRANCH.—Dickens County; flows southerly 10 miles to its junction with Duck Creek (tributary to Salt Fork of Brazos River, and thus to the Brazos) 2 miles southeast of Steel Hills in southern part of county.

WILSON BRANCH.—Johnson County; small intermittent stream west of Freeland in southern part of county, flowing into Camp Creek, and thus to Brazos River. Granbury topographic map.

WILSON CREEK.—Collin County; rises about 2 miles east of Celina; flows southeasterly 21 miles into East Fork of Trinity River (tributary to the Trinity) 3 miles southwest of Culleoka.

WILSON CREEK.—Johnson County; a stream 4 miles long flowing southwesterly into Brazos River at eastern extremity of "De Cordova Bend" in western part of county. Granbury topographic map.

WILSON LAKE.—Bowie County; about 6½ miles north of Hook's post office in northeastern part of county; formed by an old channel of Red River (tributary to the Mississippi).

WILSONS CREEK.—Matagorda County; small tributary to Tres Palacios Creek (thence to Matagorda Bay and Gulf of Mexico) in the western port of the county; flows southwesterly; length, 2 miles.

WINAN CREEK.—Bandera County; small intermittent stream in eastern part of county; flows into Medina River (and thus through the San Antonio into Guadalupe River) 5 miles northwest of Bandera.

WIND RIVER.—Hall and Motley counties; rises in southwestern part of Hall County; flows southeasterly 16 miles into Pease River (tributary to Red River, and thus to the Mississippi) at its intersection with the north line of Motley County about 4 miles northwest of Northfield.

WINDMILL CREEK.—Zavalla County; small intermittent tributary to Turkey Creek (thence to the Nueces through Elm Creek) in the northwestern part of the county; length, 9 miles. Uvalde topographic map.

WINTER CREEK (PEARL STREAM).—Walker and San Jacinto counties; rises in Walker County a few miles southeast of Huntsville; flows southeasterly 10 miles through Walker County, then southeastward 20 miles through Montgomery County into East San Jacinto River (thence to Gulf of Mexico through San Jacinto River) near the southeastern San Jacinto County line.

WIRE HOLLOW CREEK.—Runnels County; rises south of Norwood in the southeastern part of the county; flows into Mustang Creek and thus to the Colorado; length, 7 miles; intermittent. Ballinger topographic map.

WISE CREEK.—Wheeler County; a stream 4 miles long flowing southerly through northwestern part of county into Water Creek (tributary to North Fork of Red River and thus through the Red to the Mississippi) about 3 miles northwest of Mobeetie.

WOLF BRANCH.—Coryell County; small intermittent stream flowing southerly 3 miles to a point west of New Sugar Loaf, where it joins Cowhouse Creek, and thus through Leon and Little rivers to the Brazos. Gatesville topographic map.

WOLF BRANCH.—Erath and Hood counties; flows southwesterly 5½ miles to its junction with Berrys Creek (which discharges into Brazos River through Paluxy Creek) near Bluff Dale. Stephenville and Granbury topographic maps.

WOLF CREEK.—Cooke County; rises in southeastern part; flows southerly 8 miles into Isle du Bois Creek, which discharges into Trinity River through the Elm Fork of the Trinity. Gainesville topographic map.

WOLF CREEK.—Kerr and Gillespie counties; rises 6 miles northeast of Kerrville in the northeastern part of Kerr County; flows northeastward 10 miles into Pedernales River (tributary to Colorado River) 8 miles southwest of Fredericksburg in the southern part of Gillespie County. Kerrville and Fredericksburg topographic maps.

WOLF CREEK.—Llano County; an intermittent stream 4 miles in length flowing through Babyhead Creek into Pecan Creek, and thus through Llano River into the Colorado west of Babyhead in the northern part of the county. Llano topographic map.

WOLF CREEK.—Motley County; rises in the southwestern part of county; flows southeasterly 4 miles into Olive Fork of South Pease River (tributary through South Pease and Middle Pease rivers to Pease River and thus through Red River to the Mississippi).

WOLF CREEK.—Ochiltree and Lipscomb counties; rises 7 miles northwest of Ochiltree in western part of Ochiltree County; flows westerly across Ochiltree and Lipscomb counties into Oklahoma at a point 12 miles east of Lipscomb, where it enters North Fork of Canadian River (tributary to Canadian River and thus through Arkansas and Red rivers to the Mississippi) near Supply, Okla.

WOLF CREEK.—Collingsworth County; rises in the northeastern part; flows easterly 9 miles into Elm Fork of Red River (tributary to North Fork of Red River and thus through the Red to Mississippi River).

WOLF CREEK.—Hunt County; flows into Cowleach Fork of Sabine River (thence to Sabine River through Caddo Fork of Sabine River) about 3 miles east of the town of Greenville.

WOLF CREEK.—Palo Pinto County; rises 2 miles north of Brad in northwestern part of county; flows northerly 5 miles into Brazos River. Palo Pinto topographic map.

WOLF CREEK.—Throckmorton County; a northward flowing stream joining Millers Creek (tributary to the Brazos) near Throckmorton-Baylor county line in northwestern part of county.

Wolf Creek.—Tyler County; rises about 3 miles southwest of Colmesneil; flows southeasterly 14 miles into Neches River about 1 mile east of Pedigo.

Wolf Creek.—Washington County; rises near Gay Hill; flows northerly 4 miles into Yegua Creek (tributary to Brazos River) 2½ miles southwest of Scofield. Gay Hill topographic map.

Wolf Creek.—Wichita County; a stream 4 miles long flowing southerly into Wichita River (tributary to Red River and thus to the Mississippi) in the southwestern part of the county.

Wolf Fork of Tehuacana Creek.—Limestone and Freestone counties; rises about 5 miles northeast of Mexia in Limestone County; flows southeasterly 6 miles into Tehuacana Creek (tributary to Trinity River) 3 miles south of Tehuacana.

Wolf Hollow.—Montague County; rises about 2 miles northwest of Pearson in northern part of county; flows into Panther Creek (tributary to Red River and thus to the Mississippi); intermittent; very small. Montague topographic map.

Wolfpen Creek.—Hopkins County; rises in northeastern part of county; flows southeasterly 9 miles into Whiteoak Bayou (tributary to Sulphur River and thus through Red River to the Mississippi).

Wood Branch.—Tarrant County; near Benbrook; small stream flowing into Marys Creek (tributary to Clear Fork of Trinity River, thence through West Fork of the Trinity to Trinity River). Weatherford and Fort Worth topographic maps.

Wood or Hickory Creek.—Polk, Tyler, and Hardin counties; rises about 5 miles northeast of Kiam in Polk County; flows southeasterly 33 miles into Alabama Creek (tributary to Neches River) about 4 miles northwest of Village Mills in Hardin County.

Wood Hollow.—Erath County; a short intermittent stream flowing southerly into South Bosque River (tributary to Bosque River and thus to the Brazos) northeast of Lingleville; length, 2½ miles. Stephenville topographic map.

Wood Slough.—Uvalde County; small intermittent tributary to Turkey Creek (thence to the Nueces through Elm Creek) in the southwestern part of the county; length, 9 miles. Uvalde topographic map.

Woodwards Creek.—Washington County; rises 4 miles southeast of Brenham; flows northerly 5 miles into New Years Creek (tributary to Brazos River) 3 miles northeast of Brenham.

Wooley Branch.—Lee County; a small stream flowing southwesterly 5 miles into Third Yegua Creek (tributary to Yegua Creek and thus to the Brazos) 1 mile south of Darden Springs in western part of the county. Bastrop topographic map.

Wray Creek.—Harrison County; small stream in northern part of county flowing into Caddo Lake, which discharges into the Mississippi through Red River.

Wright Creek.—Llano County; small intermittent stream rising north of Babyhead; flows southerly into Mitchell Creek (tributary to Llano River and thus to the Colorado). Llano topographic map.

Wright Creek.—Jasper County; rises in the central part of the county; flows southwesterly 6 miles into Neches River.

Wrights Creek.—Trinity County; small tributary to Trinity River in northwestern part of county.

WUSSER CREEK.—Palo Pinto County; rises 1½ miles west of Jacobs Wells in southeastern part of county; flows northerly 9 miles into Palo Pinto Creek (tributary to Brazos River) 3 miles southwest of Brazos. Palo Pinto topographic map.

YANKEE CREEK.—Rockwall County; small stream flowing into East Fork of Trinity River (tributary to the Trinity) northwest of Heath in the southwestern part of the county; intermittent. Barnes Bridge topographic map.

YANKEE RHEA CREEK.—Crosby County; rises 9 miles south of Crosbyton; flows easterly 6 miles into Davidson Creek (tributary through White River to the Salt Fork of Brazos River and thus to the Brazos) in southeastern part of county.

YEGUA CREEK.—Washington, Burleson, and Lee counties; formed near Burleson-Lee county line in southeast corner of Lee County, 5 miles southeast of Dime Box by union of First Yegua and Second Yegua creeks; flows easterly 30 miles, along Burleson-Washington county line, into Brazos River near Sand Pit on Gulf, Colorado & Santa Fe Railroad. Gay Hill topographic map.

YELLOW BAYOU.—Newton County; rises about 3 miles east of Farrsville; flows easterly 10 miles into Little Cow Creek (tributary to Sabine River) about 3 miles southeast of Burkeville.

YELLOW BRANCH.—Leon County; a small stream flowing into Boggy Creek (tributary to Trinity River) in southern part of county.

YELLOW BRANCH.—Stephens County; small intermittent stream rising 7½ miles northeast of Breckenridge; flows northwesterly into Gonzales Creek (tributary to Clear Fork of Brazos River and thus to the Brazos); intermittent. Breckenridge topographic map.

YELLOWBANK CREEK.—Lavaca County; rises 3 miles east of Sweet Home; flows easterly 6 miles into Rocky Creek (tributary to Lavaca River, Matagorda Bay, and Gulf of Mexico) 7 miles south of Hallettsville.

YELLOW HOUSE RIVER.—Lubbock, Hockley, and Cochran counties; rises in a series of small lakes in the extreme northeast corner of Cochran County; flows southeasterly 60 miles into North Fork of Double Mountain Fork of Brazos River (tributary through Double Mountain Fork of the Brazos to Brazos River) near the town of Lubbock in central part of Lubbock County.

YGNACIO CREEK.—McMullen County; small intermittent tributary to Mirasol Creek (thence to Nueces River) in the southwestern part of the county; length, 3 miles.

YO-LO-DIGO CREEK.—Zavalla and Frio counties; rises in the northeastern part of Zavalla County; flows southeastward 12 miles through Zavalla County, then 3 miles through Frio County into Leon River (tributary to Frio and Nueces rivers) 5 miles northwest of Divot.

YOPON CREEK.—Washington County; rises in southern part of county; flows southeastward 3 miles into East Fork of Mill Creek (tributary through Mill Creek to Brazos River).

YORK CREEK.—Hays and Guadalupe counties; rises south of Center Point in Hays County; flows southeasterly 3 miles through Hays County, then 16 miles through Guadalupe County into San Marcos River (tributary to the Guadalupe) 2 miles south of Prairie Lea. San Marcos topographic map.

YORKS CREEK.—Madison County; small stream flowing into Trinity River northeast of Midway in eastern part of county.

YOUNGS BRANCH.—Lavaca County; small intermittent stream in northwestern corner of county; flows southerly 6 miles to its junction with Lavaca River, and thus to Matagorda Bay and Gulf of Mexico. Flatonia topographic map.

Youngs Fork of Anderson Creek.—Red River and Bowie counties; rises 1 mile east of Avery in Red River County; flows southeasterly 8 miles into Anderson Creek (tributary through Sulphur River to Red River and thus to the Mississippi) about 2½ miles southwest of Dekalb.

Zacatosa Creek.—Val Verde County; rises 6 miles north of Johnstone; flows southerly 17 miles into Sycamore Creek (tributary to Rio Grande) 1 mile north of mouth of Sycamore Creek.

Zacatosa Creek.—Webb County; rises in southwestern part of county; flows southerly 7 miles to its junction with San Isabel Creek (tributary to Rio Grande) northwest of Laredo; intermittent.

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JOHN BARTON PAYNE, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

WATER-SUPPLY PAPER 449

GROUND WATER IN THE MERIDEN AREA CONNECTICUT

BY

GERALD A. WARING

Prepared in cooperation with the
CONNECTICUT STATE GEOLOGICAL AND NATURAL HISTORY SURVEY
Herbert E. Gregory, Superintendent

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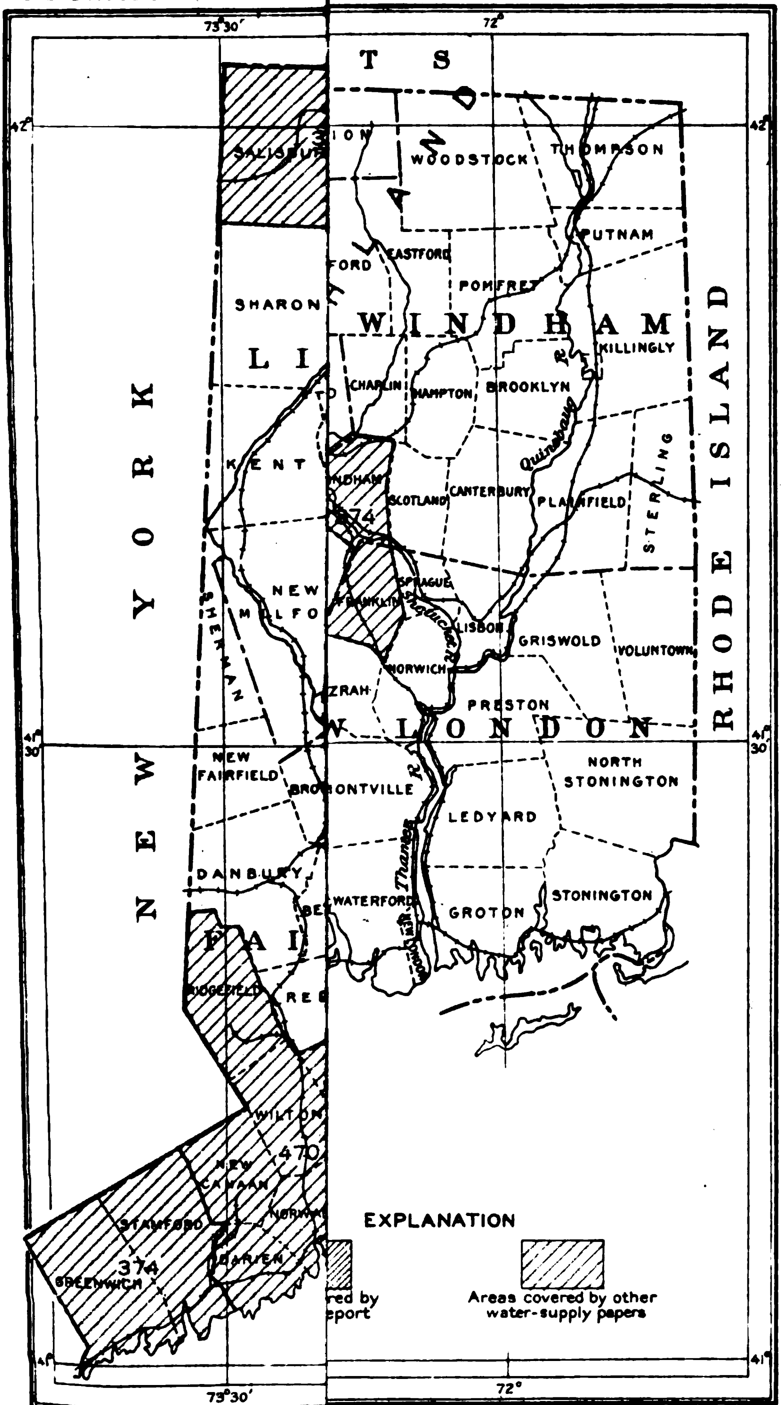
April and May, 1915. The area covered comprises about 137 square miles and includes the towns of Berlin, Cromwell, Meriden, Middlefield, Middletown, and Rocky Hill. The work consisted chiefly in collecting records of a sufficient number of wells in each town to furnish adequate data concerning the ground water. In connection with this study, the Pleistocene glacial deposits—till and stratified drift—which cover nearly all the surface, were carefully observed, and as they differ considerably in their water-bearing capacity, they were separately mapped (see Pl. II, in pocket) as well as could be done in the time available for the work. The till consists of unassorted gravel, sand, and clay, deposited by the glacial ice sheet as it melted, and in general is not a good water bearer, because its heterogeneous material is unfavorable to the easy circulation of ground water. The stratified drift consists of bedded deposits of glacial materials which were to some extent assorted and redeposited by streams that were formed largely by the melting ice, and because the materials are thus assorted the circulation of ground water is generally freer in these deposits than in the unassorted deposits of till. The map (Pl. II) shows the areas covered by stratified drift as determined with special reference to water-bearing capacity. Detailed study of the glacial geology of the region based on the origin and source of the material would probably result in considerable changes in the geologic boundaries, especially in places where the transition from stratified drift to till is obscure.

Exposures of the bedrock underlying the glacial material were also noted (see Pl. II, in pocket), but the map of bedrock geology and its structure (Pl. III, in pocket) is copied with only slight changes from geologic maps of the region prepared by Davis[1] and by Gregory and Robinson.[2] This map of the bedrock structure is reproduced with the present report because it is believed that it will be of assistance to property owners and to drillers in forecasting the kind of material that will be encountered in drilling wells. Throughout the area the successive rock formations are present in the order in which they are shown in the legend of Plate III. The first rock encountered at any place in the area will be that indicated by the color at that point on the map, and this rock is in most places successively underlain by the other formations in the order indicated in the legend. For example, in sinking wells in the city of Meriden the first rock reached is the lower sandstone, and this material continues for many hundred feet down to the ancient crystalline rocks, except, possibly, where it may be interrupted by dike rocks.

[1] Davis, W. M., The Triassic formation of Connecticut: U. S. Geol. Survey Eighteenth Ann. Rept., pt. 2, pls. 19 and 20, 1898.

[2] Gregory, H. E., and Robinson, H. H., Preliminary geological map of Connecticut: Connecticut Geol. and Nat. Hist. Survey Bull. 7, 1907.



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At Middletown, however, the first rock encountered is the upper sandstone, and this rock is believed to be successively underlain by trap sheets and by other sandstones that extend for several thousand feet down to the crystalline rocks. A few exceptions to the regular succession of the beds may be found in localities close to the fault zones, where blocks of the different rocks have been broken off and shifted from their normal positions. Such displacement and crushing may explain the presence of trap rock in the Worthington School well, at Berlin village (Berlin well 46, p. 31), though the geologic structure at this place (section C–D, Pl. III) indicates that the trap is several hundred feet below the surface. It is probable also that there are minor faults whose presence has not been detected.

The wooded areas were mapped incidentally (see Pl. IV, in pocket) because they affect to some extent the storage of ground water. The maps in this report also show certain changes in the roads and other cultural features that have taken place since the area was mapped topographically by the United States Geological Survey.

GEOGRAPHY.

The State of Connecticut may be divided into three physiographic provinces—the central lowland, the eastern highland, and the western highland. (See Pl. I.)

The area described in this report is in the south-central part of the State, and is chiefly in the central lowland, or Connecticut Valley, but its southeastern end lies in the eastern highland. From Connecticut River, which borders it both on the north and the east, the highland area rises in steep slopes that culminate in hills more than 600 feet in elevation. The surface of the lowland to the west is also broken by numerous hills and ridges, but the greater part of it is less than 300 feet above sea level, and it is dotted with lakes, ponds, and marshes.

In the part of the central lowland here considered the hills and ridges trend uniformly north-northeast. The most prominent ridge in the entire lowland area of the State is that which forms the Hanging Hills (Pl. V, *A*) 2 or 3 miles northwest of Meriden and which attains its maximum height, 1,007 feet above sea level, in West Peak.

Connecticut River is a quarter of a mile in average width where it borders the Meriden area, and it is affected by the tide for some distance farther upstream, to the city of Hartford. Mattabesset River, which drains most of the area and enters the Connecticut near Middletown, is also affected by the tide for several miles above its mouth. Quinnipiac River, which crosses the southwestern corner and receives the drainage of the southwestern part of the area, falls 60 feet in the 10 miles between South Meriden and the tidal limit at Quinnipiac.

About 30 per cent of the Meriden area is wooded (see Pl. IV, in pocket), chiefly with chestnut, oak, and maple. Practically all the woods consist of second or later growths, the mature trees having long ago been cut for timber or for fuel. Numerous wood lots in the farming areas furnish fuel and posts for local use, but the lower lands, originally heavily wooded, have been cleared and are given over to agriculture.

The cities of Meriden and Middletown—the principal centers of population—are in the towns of the same names in the southwestern and southeastern parts, respectively, of the area. Each of the other four towns—Berlin, Cromwell, Middlefield, and Rocky Hill—contains a village named for the town, and a few other communities are scattered throughout the area. Meriden and Middletown are manufacturing cities, carrying on factory and foundry industries. At most of the villages there are also factories and mills, but hay farming, fruit raising, and dairying occupy a large part of the population.

Transportation facilities in this part of Connecticut are good. The main line of the New York, New Haven & Hartford Railroad passes through the city of Meriden and the village at Berlin station; the Valley division follows the western bank of Connecticut River and passes through the city of Middletown and the villages of Cromwell and Rocky Hill; and the Air Line division passes through Middlefield and Middletown. Trolley lines connect Middletown, Meriden, and Berlin stations and neighboring villages. The Connecticut still affords transportation between river towns, but navigation on this old trade route has become of minor importance.

The climate of the region is not severe, the latest killing frost usually being in the last part of April,[1] and the earliest in the last part of October.[2] The mean annual temperature is about 47° F.[3]

The average precipitation is about 48 inches and is fairly evenly distributed throughout the year, as shown in figures 1 and 2.

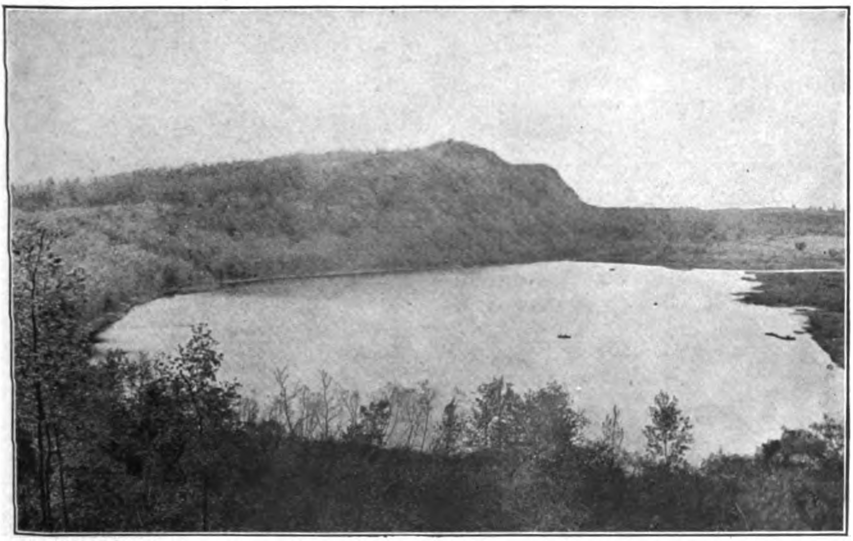
These average figures of temperature and precipitation are believed to represent closely the conditions throughout the greater part of the Meriden area. In the lowlands bordering Connecticut and Mattabesset rivers and on the higher ridges the winter temperatures are probably somewhat lower, however, and on the ridges the precipitation is doubtless somewhat greater than at Middletown, the only station in the area for which a long record is at hand.

[1] Henry, A. H., Climatology of the United States: U. S. Dept. Agr. Weather Bureau Bull. Q, pl. 20, 1906.

[2] Idem, pl. 19.

[3] Idem, p. 122; record for Southington, Conn.

A. HANGING HILLS, MERIDEN, CONN., FROM BUCKWHEAT HILL.



B. BLACK POND, MERIDEN, CONN., FROM THE NORTH.

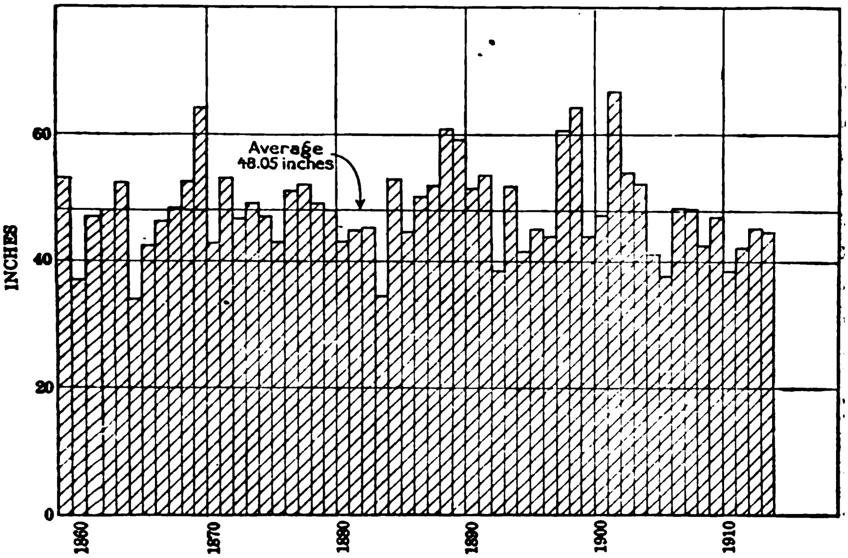


Figure 1.—Diagram showing annual precipitation at Middletown, Conn., 1859–1913, inclusive.

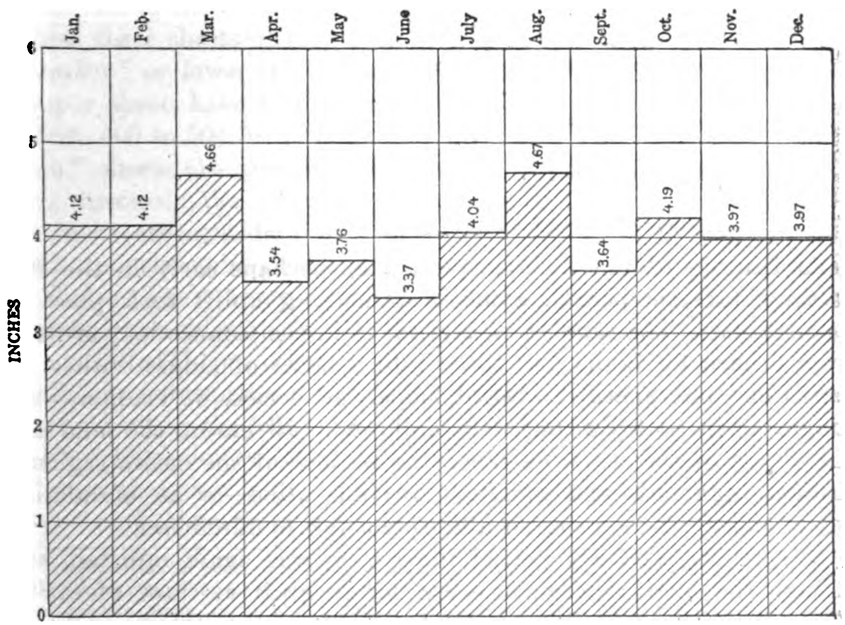


Figure 2.—Diagram showing average monthly precipitation at Middletown, Conn., 1859–1913, inclusive.

GEOLOGY.

The [illegible] shales, and lavas of the Meriden area are Triassic [illegible] the [illegible] crystalline rocks are the altered equivalents of [illegible] and [illegible] which during Paleozoic time occupied [illegible] the close of the Paleozoic era the previously [illegible] were [illegible] folded and uplifted into mountains. [illegible] the long period of erosion that followed the ranges [illegible] of these Paleozoic mountains were worn into [illegible] separated by shallow valleys. It is believed that at the close of the Paleozoic era central Connecticut was one of these [illegible] valleys near sea level or perhaps submerged. Into this valley was carried rock waste—sand, gravel, and mud—from the surrounding uplands. During the early part of the Triassic period the bottom of the valley was not much lower than its rim, but while sediments were being deposited the floor of the valley was broken and its east side was dropped much lower than the border. This great displacement deepened the valley and the thick deposits of sand and mud were gradually hardened to sandstone and shale. At three periods during the deposition of Triassic sediments molten rock made its way to the surface and spread widely as lava flows. As a result of sedimentation and igneous activity the Triassic deposits between the surface and the floor of the ancient valley form the following sequence:

1. Sandstone and shale (surface).
2. Lava.
3. Sandstone and shale.
4. Lava.
5. Sandstone and shale.
6. Lava.
7. Sandstone and conglomerate.

At the end of the Triassic period, or perhaps early in the succeeding Jurassic period, a mountain-making uplift took place in Connecticut. The sandstones and lavas in the Connecticut lowland were broken by faults and tilted into a series of ridges with steep westward and gentle eastward slope. A period of erosion, very long even in geologic time, then followed. Rivers on the land and the waves of the sea wore down the surface of the entire region—ancient highlands and uplifted lowlands alike—to an undulating plain, above which scattered hills rose a few hundred feet.

During the Tertiary period the region was again uplifted, and though the earth movements were not so great as those of earlier times, they increased the slope and activity of the streams and thus gave new impetus to erosive processes that have carved the whole region into the prominent hills and valleys that now form its main features. Triassic rocks have been worn down much more than the nore resistant ancient crystalline rocks on each side, so that a lowand, comparable with the greater depression of Triassic time, has igain been formed, bounded by an eastern and a western highland, is indicated in Plate I. Where the edges of the hard layers of trap rock were brought to the surface by the extensive faulting late in Triassic or early in Jurassic time, they have resisted erosion more than the softer shales and sandstones with which they are interbedded, and they now stand out in many places as prominent ridges in the lowland.

During the Pleistocene or glacial epoch all Connecticut probably was covered several times by great sheets of ice, which in its slow movement southward scoured off the soil that had been formed by the weathering of the rocks. When the last of the ice sheets melted, however, it deposited large quantities of gravel, sand, and clay that it had gathered up and thus formed a new coating of loose material over the bedrock; otherwise the greater part of the region would to-day consist of bare, rocky slopes on which agriculture would be practically impossible.

Since the disappearance of the ice there has been little change in the surface features of the Meriden area. The greater part of the area is included in the area of Triassic deposition, and the most prominent ridges in it are formed by the broken and tilted edges of the thickest of the three trap sheets.

These three sheets of trap rock, which have become known as the "Anterior" or lower sheet, the "Main" sheet, and the "Posterior" or upper sheet, have in this area thicknesses, respectively, of about 250 feet, 400 to 500 feet, and 100 to 150 feet. The "Posterior" and "main" sheets are separated by about 1,200 feet of sandstone and shale. Between the "Main" and "Anterior" sheets the sedimentary rocks are considerably thinner, but the series of trap sheets is both underlain and overlain by several thousand feet of sandstone and shale. The manner in which the rocks have been faulted and the prominent ridges have been formed is indicated in the structure sections (Pl. III, in pocket).[1]

Only one noteworthy dike has been found in the area. This dike is exposed along the hillside south of the city of Meriden and seems to have a maximum width of 15 or 20 yards.

The southeastern part of the area is underlain by the ancient gneisses and other crystalline rocks of the eastern highland. It is

[1] The delineation of bedrock areas and fault lines on this plate is reproduced from the map accompanying a detailed report by W. M. Davis on the region (U. S. Geol. Survey Eighteenth Ann. Rept., pt. 2, pl. 19, 1898), modified slightly in accordance with the preliminary geological map of Connecticut, prepared by H. E. Gregory and H. H. Robinson (Connecticut Geol. and Nat. Hist. Survey Bull. 7, 1907). The structure sections are patterned after the section by W. M. Davis (U. S. Geol. Survey Eighteenth Ann. Rept., pt. 2, pl. 20, 1898) and one by Joseph Barrell (Central Connecticut in the geologic past: Connecticut Geol. and Nat. Hist. Survey Bull. 23, fig. 1, 1915).

in area of rugged hills, or the change from the sedimentary lowland to the crystalline highland is not markedly shown by the surface features in this part of the boundary zone.

Although the ice sheet did not materially change the main features of the region, it caused numerous minor changes and produced a few new features, chiefly drumlins, or rounded hills of till and sand plains. In a few places eskers, or long, low ridges of stratified drift like that shown in Plate VI, A, were made by material that was probably deposited along stream channels that were formed beneath the ice sheet.

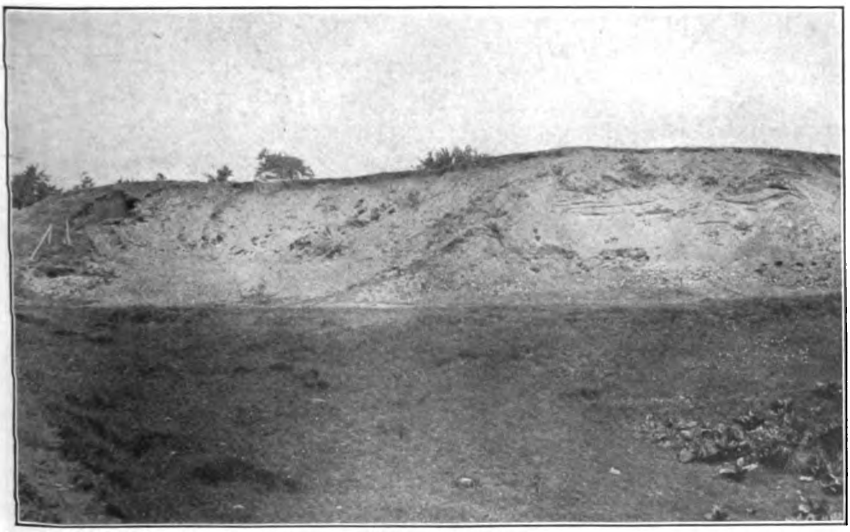
The most notable changes, however, were due to the diversion of drainage by the blocking of the former stream channels, either by the ice itself or by its deposits of gravel, sand, and clay. The drainage of the main part of the Meriden area by Mattabesset River to the Connecticut was probably substantially the same for some time prior to the glacial epoch as it is now. The course of Quinnipiac River, however, from Southington to New Haven is believed to have been more direct in Tertiary time than it is now. Some geologists consider that its present course through southwestern Meriden was adopted after the glacial epoch because of obstruction of its preglacial channel farther west by deposits left by the melting ice. The theory that Quinnipiac Gorge has been cut since the glacial epoch has been questioned by Ward,[1] who believes that the river cut this gorge in preglacial time. He suggests that relatively slight upwarping of the bedrock along an axis trending N. 70° W. may have diverted the river eastward from an earlier, more direct course.

The unstratified glacial material, or till, covers nearly all the higher lands. Along the stream valleys the glacial materials were to some extent sorted by water from the melting ice, and the gravel, sand, and clay were redeposited in more of less stratified layers, as is shown in Plate VI, *B*. This stratified drift and the till have been separately shown on the map of the surface geology (Pl. II, in pocket) because of their different characteristics as water-bearing formations.

The glacial material completely covered the region, but in general the layer of unconsolidated deposits is only a few feet thick. Over most of the higher lands it is too thin to be of value as a water carrier, the underlying rock being visible at numerous points. The localities at which the bedrock was seen by the author are indicated on Plate II by distinctive colors for the sandstone and shale, the trap rock, and the ancient crystalline rocks; doubtless there are other rock outcrops that he did not observe. In many places the outcrop is only a few feet in extent, and the size of the area of exposure is neces-

[1] Ward, Freeman, The "dam" at Cheshire, Conn.: Am. Jour. Sci., 4th ser., vol. 38, pp. 155-156, 1914.

A. ESKER NEAR BAILEYVILLE, BERLIN, CONN.



B. STRATIFIED DRIFT NEAR HARBOR BROOK, MERIDEN, CONN.

sarily exaggerated on the map. The principal rock exposures indicated on Plate II mark the prominent cliffs of the trap ridges, and the distribution of the minor exposures shows that in many places the glacial deposits covering the bedrock are very thin over large areas. Many of the bedrock exposures shown on the maps are along roads, where, of course, they are more readily observed, though the glacial material is in many places so thin that the bedrock is exposed by the road cuts and grades. On the higher lands the till is so thin that it is not easy to delineate the boundaries of the actual rock exposures. This is particularly true of the trap ridges; and the author's mapping of the exposures of trap rock on those ridges, shown on Plate II, might be modified considerably by another investigator carrying on a similar study of the region.

GROUND-WATER SUPPLIES.

WATER IN STRATIFIED DRIFT.

Stratified drift, which covers the lowlands of the Meriden area, consists chiefly of more or less definitely bedded deposits of clay, sand, and gravel, and the material as a whole offers conditions for the storage of water that are similar to those of the deposits of present-day streams, but the stratified drift contains a greater proportion of clay than is contained in those deposits, and in many places it is not so good a water bearer. The more sandy beds of stratified drift readily absorb rain, however, and are therefore important as water-bearing material.

WATER IN TILL.

The deposits of till that cover most of the Meriden area vary in character from relatively loose masses containing stones and some clay and sand to hard, compact masses of stones, sand, and clay cemented into a hardpan. The till contains large quantities of water, most of which is derived directly from precipitation, but its value as a source of supply differs according to its texture. The loose sandy or gravelly masses may yield fairly large and permanent supplies of water to wells, but the areas of sandy material are small, and those in which clay predominates are relatively large, so that till as a whole is a rather poor water-bearing material. In many places water is encountered in till at shallow depths because the clay in the till does not allow water to penetrate far below the surface, but the clay also prevents the rapid inflow of water to wells. Wells in till, therefore, usually furnish only scanty supplies, and many of them are likely to fail during periods of drought.

the [illegible] of the water-bearing material: in gravel or coarse sand, which [illegible] its water freely, fewer wells will be required [illegible] than in deposits of fine sand, which yields water [illegible]. The most efficient spacing of wells ranges from about [illegible] feet in fine sand to [illegible] feet in coarse gravel. It is usually advisable to sink wells to the full depth of the water-bearing strata in order that as large yields as possible may be obtained. Wells that are drilled or bored in loose materials must be cased, usually with iron or steel pipe, to prevent caving, and the casings must be perforated or sections of perforated casing must be used in place of the casing in the water-bearing beds in order that the water may enter. In coarse sand and in gravels the casing may be satisfactorily perforated by drilling many holes one-fourth or three-eighths inch in diameter in it or by slitting the casing after it is placed in the well by means of a powerful cutting device lowered inside the casing. In fine sands various patterns of slotted and wire-gauze screens are used. A satisfactory screen for use in fine material is also sometimes made by winding heavy wire closely around casing in which a great number of holes one-fourth or three-eighths inch in diameter have been drilled. After a well has been finished in unconsolidated material it is usually advisable to pump it strongly in order to remove the fine sand around the casing. The coarser material that remains will form a protective strainer around the casing that will lessen the tendency of the screen or perforations to become clogged and thus increase the yield of the well. Some screens that become clogged by fine sand against the outside, which can not be removed by strong pumping, can be cleaned by turning air, water, or steam under high pressure into the well.

Some waters deposit mineral matter, usually calcium carbonate or a compound of iron, on the meshes of fine screens and in time seriously reduce the yield. These materials can rarely be loosened while the screen is in the well. In localities where such difficulty is encountered, the diameter of the wells should be sufficiently large so that the sections of screen can be lowered inside the casing and be easily removed for cleaning. If the water level is at so great depth that a cylinder pump, an air lift, or other raising device must be installed in each well, casing 6 or 8 inches or larger in diameter should be used. If the water level remains during pumping within the practicable suction lift of about 25 feet, pumps may be installed at the surface and the water raised by suction, either by a pump on each well or by a pump that is connected by air-tight suction mains to several wells. Centrifugal pumps are extensively used for lifting water from shallow depths, and they are employed for lifting water from greater depths by installing them in pits.

QUALITY OF GROUND WATER.

Twenty-four samples of water were collected by the author on May 18 and 19, 1915, and were analyzed under contract for the United States Geological Survey by S. C. Dinsmore.

These analyses, except those of three waters which were probably contaminated (Berlin well No. 85, Cromwell well No. 41, and Middlefield well No. 26), are grouped in the following table according to the geologic source of the waters—whether stratified drift, till, sandstone, or trap. The springs, although probably they derive their water chiefly from the sandstone or the trap, may also contain water from the overlying glacial materials, and hence their analyses are not grouped with those of the well waters. The analyses are too few to warrant broad deductions as to the quality of the waters, but they seem to indicate certain general differences in the waters from different kinds of material.

The analyses show a range in total dissolved solids from 80 parts per million parts of water in one of the wells ending in till to 367 parts per million in one of the wells ending in trap, the average being 181 parts per million. The lowest average of total solids (104 parts per million) is shown by the analyses of the spring waters, but the lowest amount was found in the water from a well ending in till (Berlin well No. 107). In general the waters from the rock formations (sandstone and trap) are noticeably more highly mineralized than those from the glacial drift (stratified drift and till), the higher total contents being due chiefly to greater amounts of the scale-forming constituents—calcium, magnesium, bicarbonate, and sulphate.

Nearly all the waters are of the calcium-carbonate type. The average amounts of calcium and magnesium are distinctly higher in the waters from the rock than in those from the glacial drift. The average ratio of magnesium to calcium is nearly 1 to 3. In about half the waters the ratio is fairly constant, but in the others it ranges from 1 part of magnesium to 10.95 parts of calcium (Meriden well No. 52), both extremes being found in waters from sandstone.

The content of sodium and potassium is low in all the waters. Only traces of these elements are reported in five of the waters, and they form less than 1 per cent of the total solids in three others. They are highest in a sandstone water (Meriden well No. 52), in which, however, they amount to only 24 parts per million. So far as these few data show, the rock waters contain lower average amounts of these constituents than the waters from the glacial drift.

The average content of sulphates is higher in the rock waters than in the waters from the glacial drift. In only two of the samples, however (Berlin well No. 53 and Meriden well No. 52), does the sulphate radicle exceed 50 parts per million.

Chlorides form only a small percentage of the total dissolved solids, although the quantity shown by most of the analyses much exceeds that indicated by the isochlors that have been drawn for the State.[1] The percentage is higher for the waters from the stratified drift and till than for the waters from the sandstone, but this may be due to the fact that wells ending in drift, many of which are shallow dug wells, are more exposed to pollution than those ending in sandstone, most of which are drilled and are deeper.

Chemical composition of ground water in Meriden area.

[Parts per million.]

Source.	Silica (SiO_2).	Iron (Fe).	Calcium (Ca).	Magnesium (Mg).	Sodium and potassium (Na+K).[a]	Carbonate radicle (CO_3).	Bicarbonate radicle (HCO_3).	Sulphate radicle (SO_4).	Chloride radicle (Cl).	Nitrate radicle (NO_3).	Total dissolved solids at 180° C.
Wells in glacial deposits:											
Stratified drift:											
Berlin No. 30	26	Trace.	42	15	9.6	0.0	137	8.2	7.5	8.0	100
Cromwell No. 6	[illegible]	Trace.	14	5.[illegible]	6.6	.0	9.7	11	14	44	119
Cromwell No. 7	17	Trace.	11	4.5	22	.0	14	29	14	10	93
Middlefield No. 11	16	Trace.	20	5.4	Trace	.0	45	19	7.0	12	101
Average	19	Trace.	22	7.4	7.1	.0	67	15	11	18	130
Till:											
Berlin No. 51	17	Trace.	40	17	9.5	.0	153	16	17	30	226
Berlin No. 17	30	Trace.	11	3.9	4.9	.0	34	9.8	4.5	12	89
Middlefield No. 6	36	Trace.	25	8.9	16	.0	63	34	18	28	192
Average	21	Trace.	25	9.9	10	.0	83	20	13	23	166
Wells in rock:											
Sandstone:											
Berlin No. 31	22	Trace.	31	22	1.6	.0	143	11	13	30	184
Berlin No. 46	25	Trace.	46	13	2.5	.0	143	16	19	16	213
Berlin No. 53	17	Trace.	65	17	5.3	.0	102	147	5.0	.0	340
Meriden No. 7	17	Trace.	28	7.4	Trace	.0	92	10	5.0	3.0	128
Meriden No. 41	27	Trace.	50	9.6	13	.0	134	46	16	15	235
Meriden No. 52	25	Trace.	69	6.3	24	.0	129	77	23	40	339
Middletown No. 11	15	Trace.	38	14	.6	.0	117	11	7.0	14	150
Middletown No. 16	16	Trace.	33	19	.7	.0	148	10	11	18	187
Middletown No. 104	20	Trace.	41	19	8.5	.0	219	9.0	7.0	.0	213
Average	20	Trace.	43	14	6.2	.0	136	37	12	15	222
Trap:											
Rocky Hill No. 23	23	Trace.	58	32	7.0	.0	251	8.6	36	32	367
Springs:											
Meriden No. 39	27	Trace.	29	4.1	3.0	.0	92	5.3	7.0	6.0	120
Middletown No. 27	16	Trace.	22	7.2	Trace	.0	70	8.6	3.0	.0	96
Middletown No. 37	19	Trace.	21	5.6	Trace	.0	65	Trace	6.0	14	102
Middletown No. 87	15	0.20	23	4.1	Trace	.0	46	16	4.0	8.0	99
Average	19	.05	24	5.2	.8	.0	68	7.5	5.0	7.0	104
Average of all analyses	20	.01	34	11	6.0	.0	108	24	12	16	181

[a] Calculated.

Nitrate is reported to be absent from one spring water and two sandstone waters. It reaches a maximum amount in the water

[1] Jackson, D. D., The normal distribution of chlorine in the natural waters of New York and New England: U. S. Geol. Survey Water-Supply Paper 144, p. 20, 1905.

from Cromwell well No. 6, which ends in stratified drift. The high nitrate content of this water and of some of the other waters may be due to the presence of considerable organic matter, but it is evident that pollution exists in a number of the waters. Although the evidence is based on mineral and not sanitary analyses, any water that contains more than 25 parts per million of nitrate and an amount of chloride much higher than the average should receive a bacteriologic examination before being used for drinking.

Some of the waters analyzed are rather hard and poor for use in boilers, but on the whole their quality compares favorably with that of ground waters in other parts of the country.

The use of drilled wells drawing water from the rock for domestic supplies is advisable in many places, even though the rock water may be somewhat harder than the water from the glacial deposits, because more dependable supplies are assured and the danger of contamination is reduced.

Further discussions of the ground waters and statements pertaining to their economic value[1] are presented in the descriptions of the towns from which they were obtained.

DESCRIPTIONS OF TOWNS.

BERLIN.

HISTORICAL SKETCH.

The town of Berlin occupies the northwestern part of the Meriden area. The first white settler in the present town was Sergt. Richard Beckley, a planter from New Haven, who about 1660 established his home on 300 acres of land in the valley of Mattabesset River, near the present village of Beckley. Within the next few decades a settlement known as Beckleys Quarter was built up in the vicinity, and another settlement, which was known as the Great Swamp, in the lowland to the west. In 1705 these early settlements were organized as a society of the community of Farmington, which originally embraced also the town of New Britain, to the north. This society was for a time known as Farmington Village, but in 1722 the western part adopted the name of Kensington. In 1754 the northern part organized as the society of New Britain, and by 1785 the population had so increased that additional organization was warranted. The three societies of New Britain, Kensington, and the original settlement, then known as Worthington, accordingly incorporated as the town of Berlin. At the time of incorporation and for many years after Worthington (now East Berlin) was the principal place of business. In 1850 the town was again divided, the societies of Kensington and Worthington retaining the original

[1] Dole, R. B., Standards for classification; Ground water in San Joaquin Valley, Calif.: U. S. Geol. Survey Water-Supply Paper 398, pp. 50–81, 1916.

[illegible] New Britain [illegible] town of New Britain.

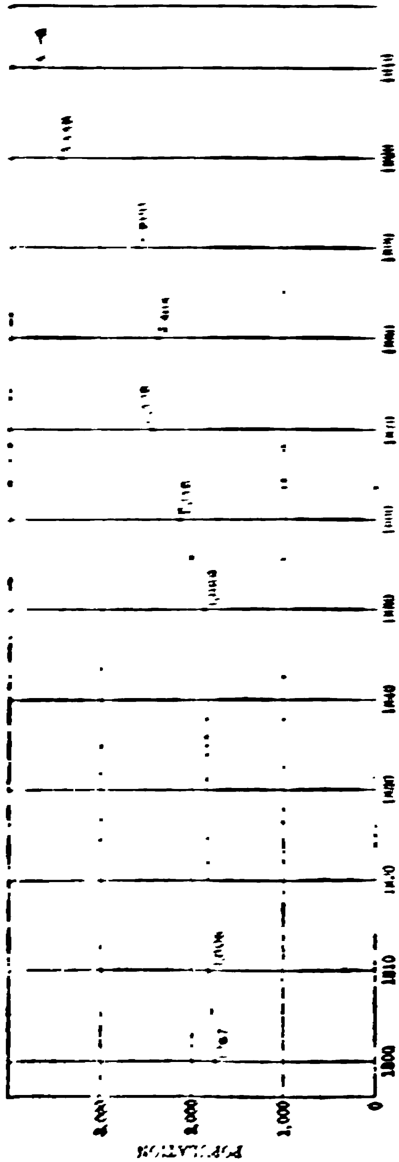


FIGURE 4.—Curve showing population of the town of Berlin, Conn.

The town of Berlin now contains the villages of Berlin, East Berlin, Beckley, and Kensington and covers an area of about [illegible] acres, according to planimeter measurements on the Meriden and Middletown topographic maps.[1] About 36 per cent of the total area is wooded. (See Plate ?.) Nearly 5 per cent is marsh land, comprised almost entirely in a tract between the villages of Berlin and East Berlin. Several ponds and reservoirs in the town cover an area of about [illegible] acres.

POPULATION AND INDUSTRIES.

Records of the early population within the present limits of the town have not been found by the author. From about 1660 until a number of years after the incorporation of the town in 1785, growth must have been fairly rapid, for in 1800 Kensington had a population of 764 and Worthington 1,0?6. During the following decade Kensington lost 8 and Worthington gained 47 people;[2] but 40 years later, shortly after the incorporation of New Britain as a separate town, the total population of Kensington and Worthington (forming the town of Berlin) had gained only 60. Since 1850 the growth has been more rapid, as is shown in figure 4.

[1] The assessor's returns for 1915 give a total of 15,1?? acres. The area given on p. 41? of the Connecticut State Register and Manual for 1915—10,516 acres—is evidently in error.

[2] Camp, D. N., History of New Britain, with sketches of Farmington and Berlin, Conn., p. 19?, New Britain, 1889.

This increase has been due largely to the railroads that were built through the town from Meriden in 1839 and from Middletown about 1845, for these transportation lines began in a few years to attract manufacturing industries.

The manufacture of tinware in Connecticut was begun in Berlin about the time of the American Revolution, and a number of other industries were early developed, water power being used for factories as well as for gristmills. At present the chief industries are the manufacture of iron bridges and other structural iron work at Berlin station, jewelry at East Berlin, and envelopes, paper bags, and other paper articles at Kensington.

The uplands of the town are noted for fruit raising, and the lowlands have long been devoted to hay raising and to pasturage. In the lowland near Beckley and near Berlin station brickmaking has also been carried on extensively for many years.

SURFACE FEATURES.

The highest points in the town of Berlin are the crest of South Mountain, on its southwest border, at an elevation of 790 feet, and the crest of Ragged Mountain, on its northwest border, at an elevation of 754 feet. The Hanging Hills, in the southern part of the town, and Lamentation Mountain, in its southeastern part, form prominent highlands that trend east of north. From these prominent ridges the surface slopes northward through rolling hills down to extensive lowlands along Mattabesset River. Where this stream leaves the town and swings eastward its channel is only a few feet above the tide.

The higher parts of the town are densely wooded with second or later growths of chestnut, oak, and other trees, and numerous wooded patches dot the lower hills. The open valley lands are, however, practically free from timber. (See Pl. IV, in pocket.)

STREAMS.

Practically the entire town is drained by Mattabesset River and its tributaries, the only exception being a small area on the southern border, which drains southward through Cathole Gorge. The western and southern boundaries of the town represent approximately the limits of the Mattabesset drainage basin in those directions. In conformity with the main topographic features, the tributaries of the Mattabesset flow in a fairly direct course east of north to the major stream, which winds eastward through the lowland of the northern part of the town, and then, after flowing southward, forming the town line for 3 miles, it turns east and southeast to Connecticut River.

[illegible]

[illegible] lower portion [illegible] measurements [illegible] given [illegible]

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

[illegible] furnished [illegible] portion [illegible] sewage beds of the [illegible] See [illegible]

The [illegible] Belcher [illegible] Meriden, and [illegible] the [illegible] A short distance [illegible] Belcher Brook is joined [illegible] Hanging Hills [illegible] water [illegible] diverted [illegible] upper branch of the Mattabesset [illegible] Belcher and [illegible] streams that [illegible] of a [illegible] discharge of North Brook [illegible] the mean flow of [illegible] second-feet.[3] Measurements [illegible] lower course of [illegible] part of the flow of [illegible] and hence is not [illegible] the Mattabesset.

A [illegible] part of New Britain [illegible] of Berlin. Its three main [illegible] half a mile north of Berlin station to

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[illegible] pollution of streams, Connecticut State Board of [illegible]

[2] A [illegible] rate of discharge in a stream 1 foot wide and 1 foot deep, flowing [illegible] 1 [illegible] foot a second or 7.48 gallons a second.

[3] [illegible] 15 [illegible] the stream one-half mile west of Westfield station, [illegible] measurement made in connection with the present investigation was 12 second-feet.

orm Willow Brook, which flows for more than a mile eastward and outhward across the lowland and joins the Mattabesset 1½ miles elow the mouth of Belcher Brook. In the saturated lowland Villow Brook is a sluggish stream whose average flow is difficult to letermine, and near its mouth the probable accession of water from he New Britain sewage beds renders measurements of the flow of he stream unreliable. The natural flow in its lower course seems to e only 1 or 2 second-feet. Webster Brook, a small, sluggish stream hat comes from the north and drains only lowlands, also enters the Mattabesset near the sewage beds.

A fairly straight brook that drains a narrow basin heading in the own of Rocky Hill enters Berlin near its northeast corner and joins the Mattabesset where that river turns from an easterly to a southerly course. The lower mile of this brook has a fairly uniform and steep grade, the fall being nearly 100 feet. Its narrow basin is only 2½ miles long, and its average flow is less than 1 second-foot. Two other streams of about the same size enter the Mattabesset from the Berlin side. One of these streams heads in Middletown on the northeast slope of Lamentation Mountain, flows first northward through a large marshy area between the villages of Berlin and East Berlin, then swings eastward and joins the Mattabesset opposite the Rocky Hill-Cromwell town line. The other stream drains the lower slopes east of Lamentation Mountain and only the lower half mile of its course is in Berlin. It joins the Mattabesset 300 or 400 yards above the Berlin-Middletown town line.

In the southern part of Berlin much of the drainage of the Mattabesset is collected in three reservoirs—Merimere, Hallmere, and Kenmere—for the water supply of the city of Meriden.

Harts Ponds in the northwest and a large pond in the southeast portion of Berlin are in part formed by dams. Ice is harvested from the southeastern pond in winter, but Harts Ponds serve chiefly as storage supplies for the mill ponds farther downstream. Chief of these ponds is that of the American Paper Goods Co., a mile southwest of Berlin station, and a newer pond that is formed by another dam half a mile below.

GEOLOGY.

The Triassic bedrock in the town of Berlin has been greatly displaced from its original position by extensive faulting. The blocks between the fault zones, which trend generally northeast, have been tilted eastward or southeastward at angles of 10° to 20° from the horizontal. The several blocks have also been offset by movements that have in general shoved the rocks on the western side of each fault southward with respect to the rocks on the eastern side. This extensive faulting has brought to the surface the broken edges of the three trap sheets in the manner shown in the cross sections C–D and E–F of Plate III (in pocket).

The rock of the "Anterior" or lower trap sheet has been brought to the surface only near the southeast corner of the town and at one place on its west border. In these places the "Anterior" trap forms only a few small exposures, as is indicated in Plate II (in pocket). The main trap sheet is well exposed in several cliffs in the southern and western portions of the town and also forms the bedrock beneath considerable areas in those portions. (See Pl. III.) The "Posterior" or upper trap sheet has been brought to the surface and forms several bands or zones in the northern and northeastern portions of the town. Three or four of the bands formed by this trap sheet are low but distinct ridges, but the others are so inconspicuous that the courses of the broken edges of the trap sheet are very largely hidden by the overlying glacial deposits.

The beds of sandstone with which the trap sheets are associated have been so displaced from their original position that the "Posterior" sandstone (which underlies the "Posterior" trap sheet) and also the sandstones beneath the other trap sheets, now form the uppermost rock beneath considerable parts of the town, although the original upper sandstone remains as the uppermost rock beneath most of the northeast part of the town. In deep drilling in the areas where the upper sandstone forms the uppermost rock the entire series of sandstones and three trap sheets would therefore be penetrated if the drill hole were continued to sufficient depth.

In the lower lands of the town, which are along the valley of Mattabesset River and its main tributaries, the bedrock is overlain by stratified glacial drift, as shown in Plate II (in pocket). Beds of brick clay are found in these deposits along the Mattabesset and appear to have been laid down in a lake that occupied the river valley for some time after the retreat of the Pleistocene ice.[1]

In a few places the stratified drift forms characteristic features other than flat lowland areas. In the lowland one-half mile to 1 mile southwest of Beckley there is a long, narrow curved ridge or esker (Pl. VI, *A*) composed of sand and gravel that was deposited along the course of a glacial stream that flowed beneath the ice sheet. A small area 1½ miles southeast of Turkey Hill and a few hundred yards west of the railroad contains several depressions that are probably kettle holes, formed by the melting of great blocks of ice that were left with other glacial débris as the main ice front melted and retreated northward.

The higher lands, which form the greater part of the town, are overlain by glacial till. On the higher slopes this loose material is

[1] Loughlin, G. F., The clays and clay industries of Connecticut: Connecticut Geol. and Nat. Hist. Survey Bull. 4, p. 24, 1905.

in many places very thin, however, and the underlying rock, which is chiefly trap on these slopes, is laid bare at numerous points.

Distinct evidences of glaciation are shown by glacial scratches at several places on the exposed rock surfaces, both in the ridges and in the lower rolling hills. A number of the lower hills are also rounded and elongated in a general northerly direction and are probably drumlins or masses of till (unstratified glacial drift), which were formed beneath the ice sheet in somewhat the same way that sand bars are formed in sluggish streams.

WATER SUPPLIES.

Surface water.—In the southern part of the town of Berlin a few families near the Meriden water main from Kenmere to Elmere reservoirs obtain domestic supplies from that source. In 1914 in the village of Berlin 113 customers were supplied by a line extending southward from the New Britain Water Co.s system.[1]

The Berlin Water Co., organized about 1912, has planned to supply the village of Berlin with water pumped from Mattabesset River, but in the summer of 1917 construction on its system had not been begun.

Except for the families in Berlin village that are supplied by the New Britain Water Co., and those in the southern portion of the town that are supplied from the Meriden main, the people of the town of Berlin depend for water on individual wells, though a few of them obtain their supplies from springs.

Water in stratified drift.—By far the greater number of wells in Berlin are dug in the unconsolidated glacial deposits. Relatively few wells have been dug or drilled into the underlying rocks. The deposits of stratified drift occupy most of the lowland areas in the town, and also cover some of the adjacent hillsides, as is shown in Plate II (in pocket). Of the 87 dug wells[2] in the town that obtain water from the glacial deposits. 35 are in the stratified drift, and although some of them get low and even fail completely during the later part of the summer, they furnish water at relatively shallow depths during most of the year. The depth of the wells differs considerably, the maximum that was noted being 43 feet in well 105 early in May, 1915. The depth of water in the wells ending in stratified drift that were measured in this town differs markedly according to the topographic position, and, as is shown in figure 3 (p. 16), the ground water stands about twice as deep on the hillsides as in the lowlands. The average depth to water in the three wells examined on hilltops was

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[1] Connecticut Public Utilities Commission Rept., 1914, p. 661.

[2] Wells 33 and 56 are omitted from this enumeration, as they obtain water from the underlying sandstone.

over three times as great as in the lowland wells. In one lowland well (No. 41), however, the depth to water was greater than in two of the hilltop wells. The analysis of the water of the deepest recorded hilltop well in drift (well 20, p. 32) shows it to be a water of moderate concentration, in which calcium and bicarbonate predominate, making it a moderately hard water for this area, although the amount is not excessive and No. 107 is the only Berlin water analyzed that contains less hardening constituents.

The detached area of stratified drift in the vicinity of Harts Ponds (see Pl. II, in pocket) is thin, and although water is obtained at shallow depths, the wells are liable to fail in summer. The stratified drift in the valley of Belcher Brook and in the stream valley between Berlin and East Berlin is also rather thin, and some of the dug wells in these localities likewise fail. In the lowland north of Mattabesset River there are extensive deposits of clay, and dug wells there do not obtain satisfactory supplies of water.

On the south side of the Mattabesset near the mouth of Belcher Brook, dug wells obtain more reliable supplies of water, for the drift there is more sandy. Large quantities of ground water probably can be developed in this locality by shallow wells drilled or bored to the bottom of the principal water-bearing strata. Wells sunk in this area should be cased to keep out fine sand, and properly screened to allow the rapid inflow of water. Ample supplies of water of good quality for domestic consumption and industrial use could probably be thus developed in this lowland area at a relatively small cost for the neighboring communities of Kensington, Berlin station, and Berlin. Below Beckley the stratified drift is clayey, and consequently good supplies of water are not so commonly obtained there as near the mouth of Belcher Brook.

Water in till.—The greater part of the town of Berlin is covered with glacial till. Over the higher lands the till is too thin to serve as a water-bearing formation, however, and both the underlying trap and the sandstone are exposed in many places. (See Pl. II, in pocket.) The average depth to water in the 52 till wells that were measured was 14.5 feet, or practically the same as in the 35 wells in stratified drift. (See fig. 3, p. 16.) The average depth to water in the wells in till on hills and slopes was noticeably less than in wells in stratified drift in the same topographic positions, however. In the lowlands, on the contrary, the average depth to water was nearly 50 per cent greater in the wells in till than in the wells in stratified drift.

The analyses of water from dug wells 51, 85 (p. 30), and 107 (p. 31), the first two being hilltop wells in till and the last on a slope in the same material, illustrate the marked differences in character in well waters obtained from the till. The water from well 51 is a moderately hard calcium-carbonate water, whereas that from well 107 is unusually free from mineral salts in solution. The high content of calcium, magnesium, and bicarbonate in the water from well 85 shows that it is a very hard water for this area. This well is in a barnyard, and the unusually large amounts of chloride and nitrate indicate that the water is contaminated by the barnyard wastes.

Water in sandstone and trap.—Records were obtained of the water level in only 13 drilled wells in Berlin. These wells range in depth from 50 to 300 feet, the average depth being 120 feet. Most of these wells are drilled into the sandstone and obtain dependable supplies of water sufficient for domestic use. Well 23, however, which is drilled at a brickyard in the lowland near Beckley, probably is sunk its entire depth in the stratified drift and obtains its water from a sandy layer below the clay deposits. Trap was penetrated in wells 46 and 77, but their main water supplies are from the overlying sandstone. Well 70 is of unusual character, as it has an artesian flow. Its natural yield of 100 gallons a minute is much larger than is usually obtained from drilled wells. The trap rock of the posterior sheet is exposed near the well, and the bottom of the well, which is reported to be 117 feet deep, may be a short distance below the bottom of the trap sheet, and the artesian flow may come from the sandstone beneath the nearly impervious trap rock.

The analyses of water from drilled wells 31, 46, and 83 (p. 32) show them to be waters of moderate concentration, in which calcium and bicarbonate, the usual constituents in this region, predominate. The water from well 83 is notable for its high content of sulphate in addition to bicarbonate. It is a rather hard water, but the low content of chloride and the absence of nitrate indicate that it is probably free from contamination. In this respect it is a better water than many others in the town.

Springs.—Only five springs were noticed in the town, and only one of these was used as a domestic supply. Three of the springs issue directly from sandstone. The other two issue from the glacial deposits that overlie the sandstone, but possibly have their principal source also in the water that is stored in crevices in the sandstone. All are of small but perennial flow.

RECORDS OF WELLS AND SPRINGS.

The locations of a number of wells, scattered throughout the town, are indicated on Plate II (in pocket), together with the depth to water in each early in May, 1915. Additional data concerning these wells and the springs that were noticed are given in the following tables and their discussion. The depth to water in the wells listed, and the relative capacity and permanence of their supplies, are believed to be typical of the many other wells in the town.

Dug wells in Berlin.

Map No.[a]	Topographic position.	Elevation above sea level.	Total depth.	Depth to water May, 1915.	Method of lift.	Remarks.
		Feet.	*Feet.*	*Feet.*		
2	Slope	210	15	12	Windlass	Gets low but never dry; trap penetrated.
3	.....do	210	19	17	.....do	Does not dry.
4	Swale	160	23	12	Well sweep	Dry every summer.
5	.....do	140	20	10	Rope and bucket	Never dry; 100 yards east of No. 4.
6	Lowland	55	14	8	Chain pump	
7	Base of hill	220	13	3	.....do	
8	.....do	220	32	16	Pitcher pump	Low in summer; 100 yards southeast of No. 7.
10	.....do	190	6	3	Windmill	
11	Slope	110	20	15	Windlass	Trap penetrated.
12	Knoll	120	17	10	Chain pump	
13	Slope	70	19	11	.....do	Dry in summer.
14	Saddle	180	31	6		Unused but never dry.
15	.....do	180	16	10	Pitcher pump	Good supply.
17	Slope	100	20	6	Windlass	
18	.....do	100	22	16	.....do	
19	.....do	70	20	14	Chain pump	
20	Knoll	90	44	42	Wheel and bucket	Dry in summer. C. W. Downe, owner. (See analysis, p. 32.)
21	.....do	120	25	20	.....do	Never dry.
22	Slope	80	38	35	Windlass	
24	.....do	120	18	11	.....do	Dry in summer.
25	.....do	60	38	22	.....do	
26	Knoll	100	33	29	Wheel and bucket	Do.
27	Slope	80	38	36		Unused.
28	.....do	130	19	14	Wheel and bucket	Dry in summer.
29	.....do	140	24	15	Windlass	
30	.....do	230	23	8	.....do	
32	.....do	140	23	18	.....do	
33	.....do	125	28	27		Most of distance in sandstone; domestic supply from spring No. 34.
35	Swale	100	6	4	Windmill	Close to drainage channel.
36	Base of ridge	55	12	5	Windlass	
37	Swale	170	29	12	.....do	
38	Ridge	175	23	14	Wheel and bucket	Low in summer; trap penetrated.
40	Lowland	55	11	6	Chain pump	
41	.....do	60	29	27	Windlass	Never dry.
42	.....do	55	18	16	.....do	Do.
43	.....do	65	14	11	.....do	Do.
44	.....do	65	11	9	.....do	Dry in summer.
45	Slope	110	31	7	Chain pump	Gets low but not dry.
47	.....do	80	21	17	.....do	
48	Knoll	80	27	20	Windlass	Never dry.
49	Slope	180	60	12	Hand pump	Dry in summer.
50	Swale	190	35	33	Windlass	
51	Small ridge	230	31	22	.....do	Algot Larson, owner. (See analysis, p. 32.)
52	Slope	230	14	11	.....do	
53	.....do	190	8	4	Rope and bucket	Never dry; trap penetrated.
55	.....do	80	23	20	Wheel and bucket	Dry in summer.
56	Swale	90	31	16	Chain pump	Nearly entire distance in sandstone.
57	Slope	160	24	20	.....do	
58	Base of hill	110	19	13	Windlass	Dry in summer.
59	Lowland	65	14	12	Chain pump	
60	Knoll	160	38	32	Wheel and bucket	
61	Slope	150	21	20		Unused.
62	.....do	110	15	6	Chain pump	Gets low but not dry.
63	Knoll	100	29	14	Windlass	
64	Slope	80	26	7	.....do	Never dry.
65	Swale	230	21	19	Wheel and bucket	Gets low but not dry.
66	.....do	200	24	20	.....do	Trap penetrated.
67	Slope	205	20	16	.....do	
68	Lowland	185	14	5	Rope and bucket	
69	Slope	190	22	15	Hand pump	Do.
71	Swale	145	19	18	Pitcher pump	Dry in summer.
72	Base of knoll	140	32	16	Wheel and bucket	Do.
73	Swale	100	22	3	.....do	Rarely goes dry; entire distance in sandy material.
74	Slope	110	25	20	Hand pump	Gets low but not dry.
78	Swale	130	26	5	.....do	Sandstone penetrated.
79	Slope	180	20	15	.....do	
81	.....do	180	16	12	Rope and bucket	
82	.....do	180	14	7		Unused.
84	Small ridge	185	21	18	Pitcher pump	Gets low but not dry.
85	Hill	195	33	32	.....do	Dry in summer. C. W. Dyer, owner. (See analysis, p. 32.)

[a] The map number corresponds with the number of the location on Pl. II (in pocket).

Dug wells in Berlin—Continued.

Map No.	Topographic position.	Elevation above sea level.	Total depth.	Depth to water May, 1915.	Method of lift.	Remarks.
		Feet.	*Feet.*	*Feet.*		
86	Base of hill	140	6	2	Pitcher pump	Gets low but not dry; sandstone penetrated.
88	Swale	130	28	22	.....do	Dry in summer.
89	Knoll	100	38	36	Wheel and bucket	Do.
90	Slope	60	14	10		Unused.
91	Swale	230	21	15	Windlass	Never dry; trap penetrated.
92	Slope	245	30	13		Unused.
93	Lowland	205	11	4	Rope and bucket	
94	Base of hill	240	25	19	Windlass	Dry during dry summers.
95	.....do	230	18	8	Chain pump	Dry in summer.
96	Slope	210	36	18	Wheel and bucket	
98	Base of knoll	200	5	3	Pitcher pump	
99	Slope	190	19	6		Unused.
100	.....do	210	14	13		Unused; drive point.
101	Lowland	150	9	6	Windmill	Large supply; sandstone penterated.
103	Slope	160	6	5	.....do	Greenhouse supply; trap penetrated.
104	Swale	180	6	1	Rope and bucket	
105	Flat	190	50	43	Wheel and bucket	Never dry; sandstone penetrated.
106	Slope	300	27	19		Unused but never dry.
107	.....do	350	21	17	Windlass	Never dry. Dennis Rahaley, owner. (See analysis, p. 32.)

Drilled wells in Berlin.

Map No.	Topographic position.	Elevation above sea level.	Total depth.	Depth to water May, 1915.	Depth to rock.	Kind of rock.	Yield.	Remarks.
		Feet.	*Feet.*	*Feet.*	*Feet.*		*Gallons per minute.*	
1	Base of hill	170	100	16		Sandstone		Dug 23 feet; drilled 77 feet. Force pump.
9	.....do	230	140	20		.....do		Force pump and electric motor.
16	Swale	110	50	8		.....do		Hand pump.
23	Lowland	30	73	40		.....do		Good supply of water at 70 feet.
31	Slope	220	97	25	6	.....do		Supplies three families. John Ross, owner. (See analysis, p. 32.)
39	Base of ridge	90	80	15		.....do		Dug 20 feet; drilled 60 feet. Force pump. Trap probably penetrated.
46	Slope	100	120	10		.....do		At Worthington school. Trap penetrated. (See analysis, p. 32.)
54	.....do	180	96	20	24	Trap		Force pump.
70	Low ridge	180	117	0	1	.....do	100	Water struck at 89 feet; temperature 52° F. Flows.
75	Slope	110	80	18	15	Sandstone	12	Engine pumps 7 gallons a minute. Trap penetrated.
77	Swale	140	135	29	60	.....do		60-127 feet in sandstone; 127-135 feet in trap.
80	Slope	180	300	15		.....do		
38	Flat	175	176	30		.....do		Mrs. Mary A. Dunham, owner. (See analysis, p. 32.)

Springs in Berlin.

Map No.	Topographic position.	Elevation above sea level.	Temperature.	Yield.	Bedrock.	Remarks.
		Feet.	*°F.*	*Gallons per minute.*		
34	Swale	110		[illegible]	Sandstone	Domestic supply.
76	Base of knoll	100	45	[illegible]	.....do	Nearly dry in summer.
87	Base of ridge	100		[illegible]	.....do	Drinking water supply.
97	Base of knoll	200		[illegible]		Unused; at roadside.
102	.....do	140	48	4		Drinking water supply.

ANALYSES OF GROUND WATER.

In the following table are given the analyses of seven samples of ground water collected in the town of Berlin. Of these samples four are from dug wells and three are from drilled wells. These analyses are discussed on pages 19–21.

Chemical composition and classification of water from wells in Berlin.

[Parts per million. Samples collected May, 1915; S. C. Dinsmore, analyst.]

	Dug wells.				Drilled wells.		
	20 [a]	51	85	107	31	46	83
Silica (SiO_2)	25	17	15	20	22	25	17
Iron (Fe)	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.
Calcium (Ca)	42	40	100	11	31	46	65
Magnesium (Mg)	15	17	48	3.9	22	13	17
Sodium and potassium (Na+K) [b]	9.6	9.5	27	4.9	1.6	2.5	5.3
Carbonate radicle (CO_3)	.0	.0	.0	.0	.0	.0	.0
Bicarbonate radicle (HCO_3)	197	153	297	34	143	143	102
Sulphate radicle (SO_4)	8.2	16	27	9.8	11	16	147
Chloride radicle (Cl)	7.5	17	131	4.5	13	19	5.0
Nitrate radicle (NO_3)	8.0	30	60	12	30	16	.0
Total dissolved solids at 180° C	209	226	617	80	184	213	340
Total hardness as $CaCO_3$ [b]	166	170	447	44	168	168	232
Probable scale-forming ingredients [b]	170	160	390	59	150	180	240
Probability of corrosion [b] [c]	N	(?)	(?)	(?)	(?)	(?)	(?)
Quality for boiler use	Fair.	Fair.	Poor.	Good.	Fair.	Fair.	Poor.
Chemical character	Ca-CO_3	Ca-CO_3	Ca-CO_3	Ca-CO_3	Mg-CO_3	Ca-CO_3	Ca-SO_4

[a] Numbers at heads of columns correspond to those on map (Pl. II, in pocket) and in tables (p. 30-31).
[b] Computed.
[c] N=noncorrosive; (?)=corrosion doubtful.

CROMWELL.

HISTORICAL SKETCH.

The town of Cromwell forms a rudely triangular area that is bounded on the east by Connecticut River and on the west by Mattabesset River. On the north a straight boundary line separates Cromwell from the town of Rocky Hill.

The first settlement within the limits of the present town was in 1650, when several families from the vicinity of the present city of Middletown moved to the lowland along Connecticut River near the mouth of the Mattabesset, which was early known as Little River. Provision in the allotment of land was originally made for only 15 families, but in 1670 there were 52 families in the locality. In 1704 the settlement, which had become known as Upper Houses, was organized as Upper Middletown parish. The parish remained a portion of Middletown until 1851, when it was incorporated and named after Oliver Cromwell as a separate town, with its present boundaries.

One post office, at the village of Cromwell, supplies the present needs of the town, as the population is largely concentrated at this village in the southeast, near Connecticut River. North Cromwell, a mile away, is a separate community, though homes are closely spaced along the main highway northward from Cromwell village.

In the western part of the town a small community has grown up, about half a mile northwest of Westfield station, but in the main the houses in the western portion of the town are scattered.

The Valley division of the New York, New Haven & Hartford Railroad passes along the eastern border of the town and through the village of Cromwell. A trolley line extending northward from Middletown parallels the railroad to Cromwell village and thence continues northward along the main highway. The western border of the town is crossed by the trolley line between Middletown and Berlin station.

The area of the town, taking the middle of Connecticut River as its eastern boundary, is about 8,700 acres, according to planimeter measurement on the Middletown topographic map, but 400 acres of this total is the water surface of Connecticut River.[1] The lower course of Mattabesset River is affected by the tide and adds perhaps 20 acres to the total water surface, and half a dozen small ponds add about 20 acres more.

A wide lowland area along Mattabesset River and a smaller area beside Connecticut River comprise a total of fully 600 acres of marsh land, or 7 per cent of the total area of the town.

Originally the town was very largely wooded, in the lowlands as well as in the hilly portions. From the greater part the timber was long ago removed for fuel and for building, but a large acreage in the northeast is still covered with second and later growths. Numerous small wood lots (see Pl. IV, in pocket) increase the total woodland to about 1,850 acres, or fully 21 per cent of the entire area.

POPULATION AND INDUSTRIES.

Early records of the population of Middle Houses are included in those of Middletown, so that definite figures of the growth of the newer settlement do not seem to be available. It is known, however, that from a population of about 250 in 1704, when the parish was formed, Middle Houses increased to a total of 754 persons in 1776.[2] During the first half of the nineteenth century commerce with the West Indies afforded a substantial industry and growth. In 1850 the proposed town of Cromwell had a population of 1,275, and in the succeeding 20 years the town's population increased nearly 50 per cent. From 1870 to 1880 there was a notable loss, owing to migration to neighboring towns where manufacturing was being more

[1] The area is given as 8,455 acres in the Connecticut State Register and Manual, p. 419, 1915.

[2] Adams, J. C., History of Middletown Upper Houses, p. 57, New York, 1908.

actively developed and to the movement of farmers to lands farther west. A considerable increase in population was attained during the next 10 years, however, and since 1890 there has been a slow but fairly uniform growth. The available records of population of the area embraced by the present town are shown in figure 5.

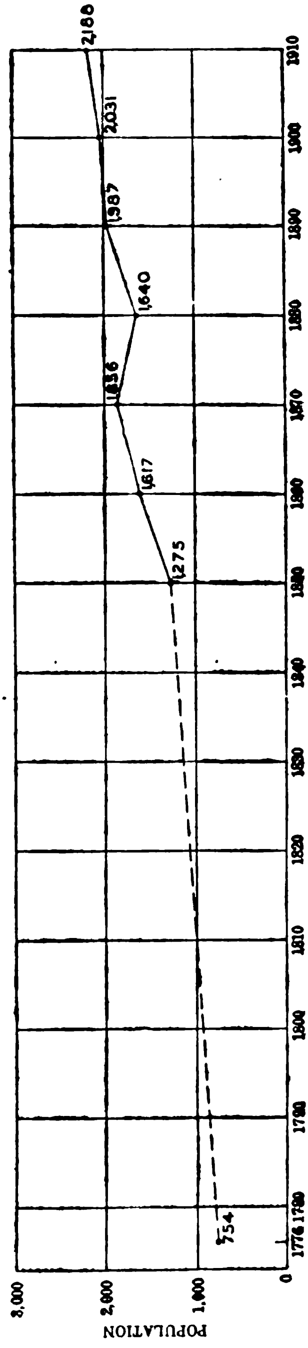

FIGURE 5.—Curve showing population of the town of Cromwell, Conn.

The principal industry in the town is agriculture. Hay and corn are the main crops, but much tobacco is grown in the northeast. A number of dairy farms have also been established within recent years at scattered points throughout the town. Employment to a number of people in the town is afforded by a few long-established factories, the principal ones being a factory for toys and light hardware and a hammer works. Within recent years extensive greenhouses near Cromwell village have also given local employment.

GEOLOGY.

Faulting, which has produced complex structure in the rock formations in Berlin, is not so pronounced in Cromwell, and the upper sandstone is the first rock penetrated in by far the greater portion of the town. The western part of the town is traversed by at least four faults, however, and the "Posterior" or upper trap sheet has thus been brought to the surface. The areas immediately underlain by this trap have been painstakingly worked out by Davis,[1] as is shown on Plate III (in pocket), but the trap rock is actually exposed at only a few places, as indicated on Plate II (in pocket). The great fault that passes between Lamentation and Higby mountains extends northeastward through Cromwell, but in this town the displacement of the rocks along the fault has been sufficient to bring the upper trap sheet to the surface only near the

[1] Davis, W. M., The Triassic formation of Connecticut: U. S. Geol. Survey Eighteenth Ann. Rept., pt. 2, pl. 19, 1898.

southern border of the town. Farther north, although the displacement of the beds is several hundred feet, the upper sandstone forms the rock immediately underlying the trap on each side of the fault. In the western part of the town an extensive fault west of the belt of upper trap rock has brought beds of the "Posterior" sandstone along its eastern side up into juxtaposition with beds of the upper sandstone along its western side. Deep wells drilled between this fault and the belt of trap rock will therefore penetrate the main trap sheet as the first trap, whereas deep wells drilled west of the fault will first penetrate the upper trap sheet. The approximate position of the several trap sheets and sandstone formations beneath the town of Cromwell is shown in the structure section C–D on Plate III (in pocket).

The lowlands along Connecticut and Mattabesset rivers are covered by stratified glacial drift. The central and northeastern portions of the town are also covered by sandy stratified deposits, which are believed to have been spread out as a plain by water from the glacial ice front at a period when ice that still lingered farther south partly dammed up the valleys of Mattabesset River and of Connecticut River near Middletown.[1] Over the sand plain and in the marsh lands along the Mattabesset and the Connecticut, the drift is probably deep, but on the western border of Cromwell village the underlying sandstone is exposed in a large abandoned quarry. Other outcrops of the sandstone in the vicinity show that the drift is only a few feet thick on the slopes near Cromwell village, and the rock has also been exposed in trenches dug for water mains.

The higher portions of the town are formed by rounded hills that are covered by glacial till and are probably, in part at least, molded into drumlin forms by thick layers of the glacial débris. In one locality in the northwest the covering of till is very thin, however, and numerous ledges of sandstone are exposed.

SURFACE FEATURES.

The central and northwestern portions of the town constitute a hilly area whose greatest elevation is reached in a hilltop in the northwest, nearly 300 feet above sea level. A number of other hills are more than 200 feet high, but the area is deeply incised by several streams, and the slopes also drop rapidly to the west and south to Mattabesset River.

In the northeastern portion of the town lies a sand plain that has a mean elevation of about 180 feet, but it has been dissected from the north and from the south by the headwaters of minor streams. On the east the plain drops rapidly to Connecticut River. On the south-

[1] Loughlin, G. F., The clays and clay industries of Connecticut: Connecticut Geol. and Nat. Hist. Survey Bull. 4, p. 24, 1905.

east the surface slopes down to a wide expanse of lowland extending to the river.

The southeast corner of the town is occupied by an extensive marsh land between the Connecticut and the Mattabesset, and this marsh extends up the Mattabesset for nearly 3 miles above its mouth. Connecticut River along the entire eastern side of the town and the Mattabesset to at least the upper limit of the marsh land are within the influence of the tide. All the lowlands of the town are therefore only slightly above sea level.

Most of the hilltops and adjacent slopes have long been cultivated, and only detached areas of woodland remain in the central and western portions of the town. The largest remaining wooded areas are along stream valleys on the northern border, and on the slopes from the sand plain down to the Connecticut.

STREAMS.

Connecticut River has a fairly uniform width of about a quarter of a mile where it forms the eastern boundary of Cromwell. It is navigable from its mouth to the city of Hartford, 15 miles above Cromwell village, and formerly was the principal means of transportation for the region. Since the construction of railroads, however, the river transportation has became of minor importance.

The eastern portion of the town drains fairly directly to Connecticut River through a few small brooks. Dividend Brook, which has its course mainly in Rocky Hill, swings southward and then sharply northeastward to the Connecticut. The southernmost part of its course crosses the Rocky Hill-Cromwell boundary and drains the northeastern border of Cromwell. Its average flow at the road crossing at the southernmost point of its course is probably less than 1 second-foot. On May 6, 1915, it carried 0.6 second-foot of water.

A small tributary that parallels the north border of the town has been locally called Peat Swamp Brook. Peaty deposits in its marsh-land course were intermittently prospected for many years, but the material does not seem to be of commercial value.

A smaller perennial stream drains a portion of the eastern slopes of the town directly to the river.

The greater part of the sand plain in the north-central part of the town is drained by a brook that flows southeastward through North Cromwell village to the Connecticut. In its upper portion this stream is ponded in three places, the upper two ponds regulating the flow to the lowest, which furnishes power to one or more factories. Below North Cromwell the brook flows for nearly a mile across the lowland to Connecticut River. Because of the several ponds and the mill dam at and above North Cromwell a satisfactory estimate of the normal flow of the brook was not obtained. It seems, however, to have a considerably larger discharge per unit drainage area than Dividend Brook. Its upper course is intrenched 60 feet or more in the sand plain, hence it probably receives considerable water by seepage inflow from the deep sandy deposits and perhaps also by springs that issue close to its channel.

The southern and western portions of the town are drained by a number of small brooks that flow directly to Mattabesset River, which forms the town boundary on the south and west. The Mattabesset itself is affected by the tide for half its course along the Cromwell border. Above the limit of the tide it is a sluggish stream, so polluted by factory wastes and sewage that few fish inhabit it. Its average flow during the low water of summer and autumn is about 50 second-feet at the northwest corner of the town. Half a mile above its mouth it is joined from the south by Coginchaug River, and it enters the Connecticut with a mean low-water discharge of about 70 second feet.[1] The stream receives a normal low-water accession of only about 2 second-feet between the northwest corner of Cromwell and the mouth of the Coginchaug. Several of the individual brooks that enter this portion of the Mattabesset both from the south and from the north at times carry more than 2 second-feet, however. On May 5, 1915, the brook that enters the north side of the Mattabesset one-third of a mile west of Westfield station had a discharge of 3.7 second-feet, at a time when the Mattabesset shortly above the mouth of this brook carried 42 second-feet.

The brooks that drain the southern and western slopes of Cromwell are at present almost unused for the development of power, but in former times the largest ones were of some importance for this purpose. A grant to a mill site on Chestnut Brook[2] was obtained in 1655, but of late years this stream has been used little if at all for the development of power.

WATER SUPPLIES.

Surface water.—A few years ago a pumping plant was established shortly below the power dam at North Cromwell, and water from the brook was delivered to consumers in Cromwell village. In 1915 this plant, owned by the Cromwell Water Co., a private corporation, comprised an electrically driven centrifugal pump, lifting water from the brook below the power dam to two standpipes in the highest part of the village. (See Pl. IV, in pocket.) The distribution system comprised 8 miles of mains. The pump was run three to eight hours each night to supply the average daily use of about 175,000 gallons.

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[1] Report on the investigation of the pollution of streams, p. 45, Connecticut State Board of Health, 1915.

[2] Adams, J. C., Middletown Upper Houses, p. 15, New York, 1908.

In 1915 the Cromwell Water Co. supplied about [illegible]00 people,[1] or about two-thirds of the population of the town. The remaining third, scattered throughout the town, depend chiefly on shallow dug wells for water supply. A few drilled wells have been put down in the western part of the town in places where the glacial material is thin, and a few springs are used.

Water in stratified drift.—As the greater part of Cromwell is covered by stratified drift, most of the dug wells obtain water from this material. The average depth to water in the 23 wells in stratified deposits that were measured early in May, 1915, was 12.5 feet. The water level differed greatly in the individual wells, but as shown in figure 5 (p. [illegible]) the average depth on hills, slopes, or lowlands in the stratified drift did not differ greatly. In general the depth to water in the eastern part of the sand plain that occupies the north-central part of the town was greater than in the western portion of the plain and indicated a marked eastward slope of the water table, caused, presumably, by the deeply intrenched drainage course of the brook that flows through North Cromwell. Although the wells in the sand plain obtain ample supplies of water for individual families, the greatest available supplies of ground water in the town are probably stored in the lowland east of Cromwell village and in the more marshy land in the southeast corner of the town. Wells were not seen in either area, and no test borings were reported which might show the character of the stratified drift in either place. It is probable that the lowland along the Mattabesset is underlain by clay beds similar to those of the brick-clay pits near Newfield, and hence large yields of water could not be obtained from wells sunk in these lowlands. The area east of Cromwell village is, however, probably underlain by more sandy material, in which there may be large supplies of water that could be developed by shallow wells and pumping plants for the use of neighboring industrial establishments.

Analyses of water from three dug wells in the stratified drift (see table, p. 40) show that some of the wells, of which Nos. 6 and 7 are examples, yield very soft and pure water. Other domestic wells, however, which are situated adjacent to kitchens or to outhouses may become dangerously polluted by organic wastes, resulting in abnormally high amounts of chloride and nitrate. Well 41 is an example of such a well; the chloride and nitrate radicles constitute more than half of the total solids, which they have increased to an extent that is abnormal for this area.

Water in till.—The records of 10 dug wells in the till, chiefly in the western portion of the town, indicate that the water level is there on an average about three-quarters as deep as in the stratified drift of the lower areas. There is, however, as marked a variation in the

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[1] Connecticut Public Utilities Commission Rept. 1915, p. 649.

water level in individual wells in till as there is in the wells in stratified drift.

Water in sandstone.—Four drilled wells were observed in the town. All are in the western part, in localities where the glacial drift is too thin to serve as a reliable water-bearing formation. The wells are drilled 63 to 142 feet deep, the depth to water in them being 20 to 30 feet in May, 1915. In the deepest well (No. 26) the "Posterior" trap sheet was drilled through and a dependable water supply was obtained from the underlying sandstone. In the other three wells only sandstone was penetrated below the till.

Springs.—Three of the four springs noticed in the town are used for domestic supply. Each of these three springs issues from the stratified drift and yields only about half a gallon a minute, but each is said to have a perennial flow. The fourth spring issues from the trap in a small road-metal quarry and supplies a roadside trough.

RECORDS OF WELLS AND SPRINGS.

The wells and springs indicated on Plate II (in pocket) and tabulated in the following list are believed to be typical and to show the ground-water conditions in different portions of the town.

Dug wells in Cromwell.

Map No.	Topographic position.	Elevation above sea level.	Total depth.	Depth to water May, 1915.	Method of lift.	Remarks.
		Feet.	*Feet.*	*Feet.*		
1	Knoll	110	22	3	Rope and bucket	Never dry.
4	Slope	140	25	8	Windlass	Dry in summer.
6	Flat	145	15	10	Pitcher pump	Never dry. Benjamin Rooney, owner. (See analysis, p. 40.)
7	Slope	180	37	35	Windlass	Never dry. J. W. Gardner, owner. (See analysis, p. 40.)
8	.....do	180	23	12	Pitcher pump	Dry in summer; water level affected quickly by rains.
9	Base of hill	190	10	6	Windlass	Never dry.
10	Flat	175	7	4	Rope and bucket	
11	.....do	175	21	12	Windlass	Do.
12	Knoll	190	19	13	Hand pump	Do.
13	Flat	185	29	26	Windlass	Gets low but not dry.
14	.....do	165	23	20	.....do	Never dry.
15	Swale	50	9	8	.....do	In small, marshy patch.
16	Slope	150	11	4	Rope and bucket	Dry in summer.
17	.....do	110	20	14	Wheel and bucket	
19	.....do	170	18	14	Hand pump	Never dry; supplies several families.
20	Flat	170	9	6	Wheel and bucket	Never dry.
21	Base of knoll	190	18	8	Windlass	Dry in summer.
22	Knoll	200	18	6	.....do	
23	Slope	50	15	9	.....do	Never dry.
24	.....do	55	18	12	.....do	
25	.....do	50	15	8	Wheel and bucket	Dry in dry summers.
27	.....do	80	18	14	Windlass	Supplies 5 families during summer; trap penetrated.
29	Slope	30	15	9	Wheel and bucket	
31	Base of hill	30	14	9	Windlass	
33	Swale	30	14	12	Chain pump	Never dry.
34	Knoll	170	18	15	Pitcher pump	Dry in summer.
35	Saddle	130	11	7	Windlass	Never dry.
36	Slope	95	30	16	.....do	
37	.....do	110	28	18	.....do	Only slightly used.
38	.....do	180	32	11	.....do	
39	Base of hill	30	17	9	.....do	
40	Slope	60	20	17	.....do	Dry in summer.
41	Lowland	20	15	6	.....do	O. A. Perkins, owner. (See analysis, p. 40.)

Drilled wells in Cromwell.

Map No.	Topographic position.	Elevation above sea level.	Total depth.	Depth to water May, 1915.	Depth to rock.	Kind of rock.	Yield.	Remarks.
		Feet.	*Feet.*	*Feet.*	*Feet.*		*Gallons per minute.*	
2	Slope	110	63	30		Sandstone		Water struck at 30 feet.
3	....do	130	112	30		....do		Water rose to 8 feet when first struck.
26	....do	90	142	20		Through trap to sandstone.		
28	Knoll	70	65	20	9	Sandstone	4½	

Springs in Cromwell.

Map No.	Topographic position.	Elevation above sea level.	Temperature.	Yield.	Bedrock.	Remarks.
		Feet.	*°F.*	*Gallons per minute.*		
5	Slope	150	48	½	Sandstone	Part of domestic supply.
18	....do	120		½	....do	Domestic supply.
30	....do	70	50	1	Trap	Supplies roadside watering trough.
32	....do	70		½	Sandstone	Part of domestic supply.

ANALYSES OF GROUND WATER.

The following table contains the analyses of three samples of water from dug wells in the town of Cromwell. The analyses are discussed on pages 19–21.

Chemical composition and classification of water from wells in Cromwell.

[Parts per million. Samples collected in May, 1915; S. C. Dinsmore, analyst.]

	6 [a]	7	41
Silica (SiO_2)	15	17	22
Iron (Fe)	Trace.	Trace.	Trace.
Calcium (Ca)	14	11	107
Magnesium (Mg)	5.0	0.8	29
Sodium and potassium (Na+K) [b]	8.8	10	170
Carbonate radicle (CO_3)	.0	.0	.0
Bicarbonate radicle (HCO_3)	9.7	14	105
Sulphate radicle (SO_4)	11	29	117
Chloride radicle (Cl)	14	14	102
Nitrate radicle (NO_3)	44	10	500
Total dissolved solids at 180° C	119	93	1,106
Total hardness as $CaCO_3$ [b]	56	47	386
Probable scale-forming ingredients [b]	65	57	390
Probability of corrosion [b] [c]	C	C	C
Quality for boiler use	Bad.	Bad.	Very bad.
Chemical character	Ca-NO_3	Ca-SO_4	Na-NO_3

[a] Numbers at heads of columns correspond to those on map (Pl. II, in pocket) and in table (p. 39).
[b] Computed.
[c] C = corrosive.

MERIDEN.

HISTORICAL SKETCH.

The town of Meriden occupies the southwestern part of the area considered in this report. The area was first organized as a parish of the town of Wallingford, which adjoins Meriden on the south.

The parish is generally considered to have been named from Meriden, in Warwickshire, England, but doubt as to this source of the name has been raised in favor of a farm near Dorking, in Surrey County, England.[1]

In 1730 the population of the parish was only about 250, for immigration was not rapid, and after the French and Indian War migration was westward rather than into the Meriden region. By the close of the American Revolution the population of the parish of Meriden was probably about 500, and in 1806, when the settlement was incorporated as a separate town, it contained about 1,100 people.[2] The present population is concentrated in the center of the town, in the city of Meriden, which was chartered in 1867. South Meriden and East Meriden are communities about a mile beyond the corporate limits of the city.

The area of the town is close to 15,000 acres, according to planimeter measurement on the Meriden and Middletown topographic maps.[3] Nearly 24 per cent of the total area is wooded (see Pl. IV, in pocket) with small second and later growths of chestnut, oak, maple, and other native trees. There is only about 200 acres of marshland in the town, and this land consists largely of strips along the principal brooks. Nearly 300 acres, or 2 per cent of the total area, is covered by the water surfaces of several ponds.

POPULATION AND INDUSTRIES.

During the first few decades after incorporation Meriden gained only slowly in population. The development of manufactures, which were early started in and near the city, soon gave impetus to settlement, however, and between 1840 and 1850 the population nearly doubled. An even greater increase took place in the succeeding decade, and since 1860 the growth has continued at a rapid rate, Meriden being now one of the most important manufacturing cities in the State. The accompanying diagram (fig. 6) shows the growth in population of the town since its incorporation, and of the city since 1880, when the population of the city as distinct from the town first appears in the census reports.

The principal industry of Meriden is the manufacture of sterling silverware and plated ware, on which account it is sometimes called the "silver city." Other important industries are the manufacture of nickel and granite ware, of Britannia ware, cut glass, electric and other lamps, clocks, furniture trimmings, and many minor articles. Cutlery and other small articles are made at South Meriden, and several small factories are located in East Meriden

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[1] Curtis, G. M., and Gillespie, C. B., A century of Meriden, p. 46, Meriden, 1906.

[2] Idem, p. 333.

[3] The area of 10,483 acres, given on p. 432 of the Connecticut State Register and Manual, 1915, is evidently in error.

The rolling slopes outside the city are extensively cultivated, field crops being raised chiefly, though there are numerous small orchards of apples and other deciduous fruits.

The double-track line of the New York, New Haven & Hartford Railroad passes through the city of Meriden and gives easy access both to New Haven, on tidewater, 18 miles to the south, and to Hartford, the State capital, at the head of navigation on Connecticut River, 18 miles to the north. Interurban trolley lines connect Meriden with villages to the east and to the west, and the principal

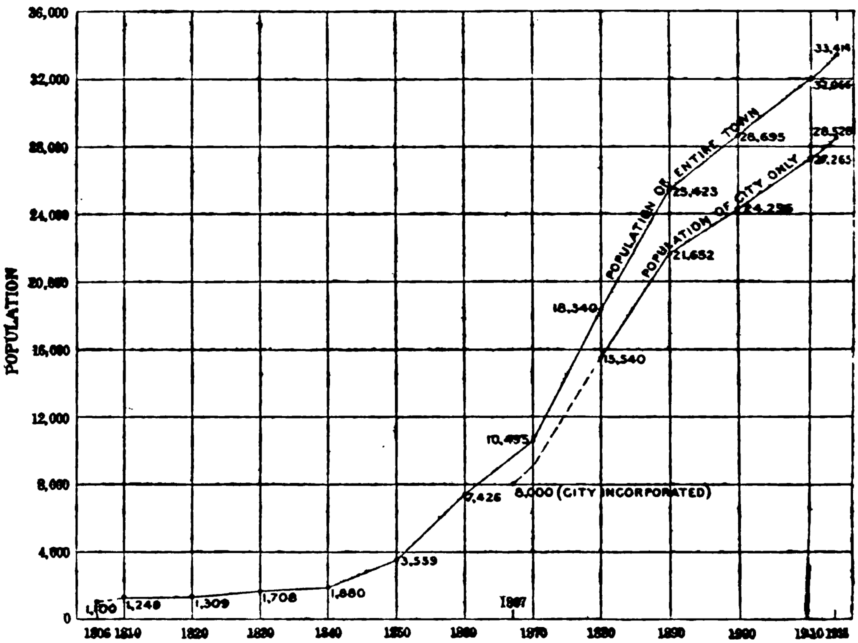


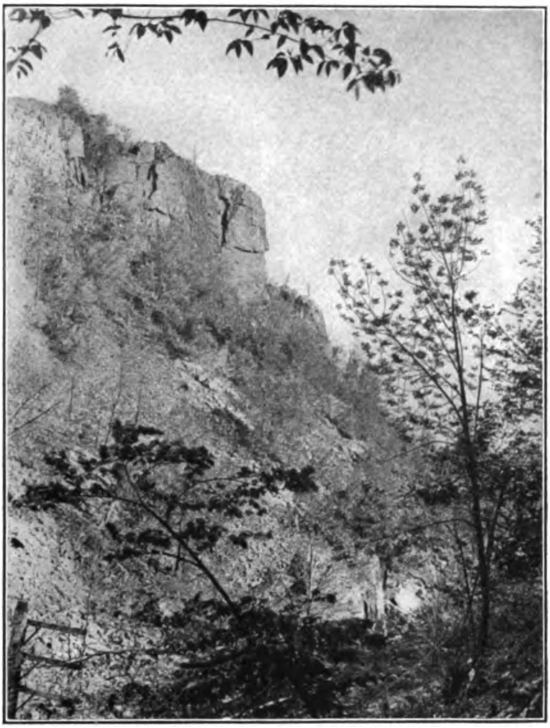
FIGURE 6.—Curves showing population of the town and city of Meriden, Conn.

highways are either concreted or metaled, affording easy means of communication by automobile.

GEOLOGY.

The geologic structure in the town of Meriden is largely determined by two extensive faults that cross it in a northeast-southwest direction. (See Pl. III, in pocket.) Of these major faults the western one is believed to have caused a displacement of not less than 2,000 feet and the eastern one of not less than 1,300 feet.[1] Along these two great fault zones uplift and offset of the rocks has taken place and the "Main" trap sheet has been broken and

[1] Davis, W. M., The Triassic formation of Connecticut: U. S. Geol. Survey Eighteenth Ann. Rept., pt. 2, p. 96, 1898.



A. CLIFF OF TRAP IN CATHOLE GORGE, MERIDEN, CONN.

B. BOULDER-STREWN FIELD NEAR HARBOR BROOK, MERIDEN, CONN.

uptilted, so that its edges now form the cliffs of Hanging Hills, Lamentation Mountain, and the Higby-Beseck mountain mass. A near view of one of these cliffs is shown in Plate VII, *A*. The manner in which repeated faulting has caused the "Main" trap sheet to form the extensive cliffs of the Hanging Hills is shown in the structure section E–F on Plate III. The uplift was so great that the "Anterior" or lower trap sheet is also exposed along the bases of the mountains, as shown on Plate III. This lower trap sheet forms a prominent shelf or bench below the main cliffs of the Hanging Hills, as shown in Plate V, *A*. At the base of Lamentation Mountain it also forms a minor ridge, but along Higby and Beseck mountains it does not appreciably affect the topography. The apparent secondary bench of Beseck Mountain, south of Black Pond, that is shown in Plate V, *B*, is a more distant portion of the cliff formed by the "Main" trap sheet.

In the northern and eastern portions of Meriden the successive rock formations from the lower sandstone upward to the "Main" trap sheet are exposed. The lower sandstone is the uppermost rock in the greater part of the town, and in drilling wells in these areas, except for the remote possibility of penetrating a dike, no trap rock will be met. One dike of diabase rock, which is similar to the trap rock of the several sheets, is exposed at several points south of Meriden, but it is believed to be the only dike of note in the region. A small dike near Baileyville, in Middlefield, has been described by Griswold.[1] The northernmost exposure of this dike that was noticed is in the unpaved roadway of Prospect Halls Avenue. The dike there appears to be only 2 or 3 feet wide, but half a mile southward, in the western portion of Walnut Grove Cemetery, it has a width of 15 feet or more. At this locality it is best exposed in a small quarry or pit, which is probably the Golden Parlor mine, where prospecting for copper was carried on many years ago. Farther south the dike rock is well exposed as a very low rocky ridge. Its surface exposures terminate at a road cut, 4 feet deep, where the dike is about 40 feet wide. The eastern contact between the dike and the sandstone is well shown in this cut.

The lands along the principal streams in the town are covered by stratified drift. The bedded character of this material is shown in numerous gravel banks, such as the one illustrated in Plate VI, *B*. Well records show that in many places this drift is shallow, but along the lower course of Harbor Brook the deposits are deep. Through the center of the city of Meriden the western border of the lowland along Harbor Brook is probably marked by a steep, buried bedrock slope; for it is said that whereas the western portion of Winthrop

[1] Griswold, L. S., A basic dike in the Connecticut Triassic: Harvard Coll. Mus. Comp. Zool. Bull., vol. 16, pp. 239–242, 1893.

Hotel is built on sandstone, the eastern portion rests on piles driven into unconsolidated materials.

South Meriden is situated on a sand plain that extends from Quinnipiac River westward to the hills that limit the river valley and southward down the river valley for several miles. This plain was probably formed by the reassorting and redeposition of sand and finer materials by water that was produced by the melting of the glacial ice and that spread over the valley before a definite channel had been established. In these porous sand-plain deposits the city of Meriden has constructed very successful filter beds a short distance below the town line.

In the southeastern portion of the town there is a low but well-developed esker in the upper part of the valley of Harbor Brook. A road makes use of this low, narrow ridge, which forms a well-drained thoroughfare through the meadow land on each side.

Rolling hills occupy considerable portions of the town. Most of these hills are elongated in a uniform direction east of north. They are drumlins, but around their bases and even on some of the higher slopes the till is very thin. Unstratified material also occupies some of the lower lands and in the lee of the prominent trap ridges occasionally forms boulder-covered areas, like that shown in Plate VII, *B*. In numerous places, especially in road cuts, the underlying sandstone is well exposed for distances ranging from a few yards to several rods. The observed areas of such exposures are necessarily exaggerated on Plate II, in order that they may be shown on the map. Doubtless the sandstone is exposed in many other places that were not seen by the writer.

SURFACE FEATURES.

The highest points in the town, and by far the most prominent elevations in the central lowland of Connecticut, are the Hanging Hills, which reach a maximum elevation of 1,007 feet in West Peak, on the northwest border. East Peak, on which an observation tower 38 feet high has been erected, and South Mountain and Cathole Mountain, farther east, are also prominent though lower summits of the Hanging Hills. In the northeast part of the town Lamentation Mountain proper and its southern extension, known as Chauncy Peak, also form prominent cliff-bordered masses. These higher areas are practically all wooded and have the usual second and later growths of the native trees.

The central portion of the town comprises a belt of lowland extending from the headwaters of small streams in the northeast to the valley of Quinnipiac River in the southwest, the lowest point in the town being where this stream crosses the southern border, at an elevation of about 55 feet.

The lowland of the town is bordered on each side by rolling hills, which form the greater part of the surface.

STREAMS.

Quinnipiac River enters the town of Meriden through a gorge cut 200 feet deep in sandstone and crosses the southwest portion of the town, receiving the drainage from nearly all of it. In its upper portion the stream is used for power development at a number of places, and at South Meriden the Meriden Cutlery Co. obtains power at the outlet of Hanover Pond, a water body of about 35 acres that is formed chiefly by a dam across the river. Mr. Harold T. Burgess, civil engineer, of Meriden, has furnished the curve of discharge of the river at the outlet of Hanover Pond, which is presented in figure 7.

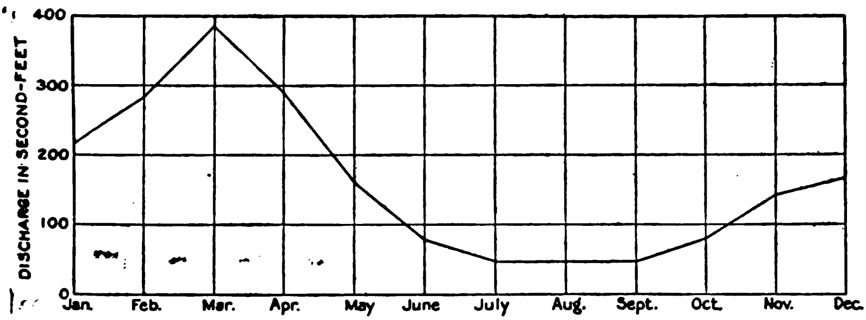


FIGURE 7.—Diagram showing monthly discharge of Quinnipiac River at outlet of Hanover Pond, Meriden, Conn.

This record shows that the maximum flow, which is usually attained in March, is about eight times the minimum flow of the summer months. Storage ponds, however, regulate the flow of the stream sufficiently to make it fairly dependable for the development of power throughout the year.

Harbor Brook, which empties into Hanover Pond, drains the eastern part of Meriden through its North Branch, which heads in marsh land at the base of Chauncy Peak, and through its other branches it drains the southeastern part of the town. In their upper portions these streams are fairly pure, and shortly below their junction they supply a chain of ice ponds, but below these ponds the main stream flows through the city of Meriden and is polluted by factory wastes. The daily flow of the stream is affected by the opening and closing of the pond gates, but the average discharge into Hanover Pond is probably about 10 second-feet.

Cathole Brook drains the slopes on each side of the mountain of the same name, and flows southward through a small valley. Its western branch has been dammed and a small pond has been formed at the entrance to Cathole Gorge. This branch normally carries perhaps 1 second-foot of water, and the main or eastern branch carries somewhat more. About 1 mile above Hanover Pond Cathole Brook joins Sodom Brook, which heads in the slopes of South Mountain. Shortly below the junction of these two streams Crow Hollow Brook, which heads near the base of West Peak, also enters, and the combined discharge into Hanover Pond averages perhaps 5 second-feet of water.

Meetinghouse Brook and its tributary Spruce Dale Brook are small streams that drain a southern portion of the town southward to the Quinnipiac.

WATER SUPPLIES.

Surface water.—The municipal water supply of the city of Meriden is furnished by several reservoirs, which are shown on Plate IV (in pocket). Merimere reservoir, which was constructed in 1888 in the gap between East Peak and South Mountain, has an available capacity of about 341,000,000 gallons and furnishes a gravity water supply. Kenmere reservoir was later built on another stream, and the water is being pumped from it to Elmere distributing reservoir. In 1895 Hallmere reservoir was constructed, higher up on the same stream, for storage of water. Excess water from Elmere reservoir is also diverted into Hallmere reservoir by a ditch across the low divide between the two drainage courses. With the rapid growth of the city the reservoir supply has proved inadequate during the late summer, and emergency pumping stations at Hanover Pond (Hanmere station) and at Baldwin Pond (Baldmere station) have been used for short periods. The quality of the water from these two ponds is poor, however, and in order to provide for a better and more adequate supply, Broad Brook reservoir, in the town of Cheshire, was constructed in 1915. This reservoir has a capacity of 1,200,000,000 gallons. From it the water is lifted by electrically driven centrifugal pumps to a distributing reservoir on Johnson Hill. Thence the water is supplied to the mains by gravity under a head of about 250 feet in the business section of the city. Pollution of this new supply has been guarded against by the purchase of farms adjacent to the reservoir and the removal of the buildings.

In excavating for the foundations of the Broad Brook dam well-preserved glacial scratches were found on the sandstone underlying the till. An average thickness of 28 feet of sandstone was removed until diabase was reached, evidently dike material, containing copper stains. This rock was uncovered at a depth of about 44 feet, entirely across the dam site. Similar dikes a few miles to the south have long been prospected for minerals.

In addition to the people within the city limits, a few families in the northern part of the town of Meriden and in the southern part of Berlin, near whose houses the city mains pass, are supplied with water from this system.

Several industrial establishments in the city have sunk wells to supply their factories. These wells have been only partly successful, however, for the water obtained is too hard to be satisfactory for boiler use, and the factories depend on the city supply for water for this purpose.

The community of East Meriden and the numerous farmhouses throughout the town depend on individual wells for a water supply.

Water in stratified drift.—Only a small part of the town of Meriden is covered by stratified drift and only 11 of the 55 dug wells observed that obtain water from the glacial materials are sunk in stratified drift. Wells 6, 9, 26, 35, and 106 obtain water from the sandstone, and hence are not included in the present discussion. The average depth to water in the 11 wells in stratified drift was 15 feet early in May, 1915, but the water level in the several wells ranged from 7 to 24 feet. (See fig. 3, p. 16.) The stratified drift along the stream valleys above Hanover Pond seems from the available records neither to be very deep nor to contain extensive layers of good water-bearing sand and gravel. In the plain south of Hanover Pond, however, the stratified drift seems to contain extensive water-bearing layers of sand, and ground-water development on a large scale in the town could probably be best undertaken in this lowland. The Meriden sewage beds discharge into the sand a short distance south of the town line, but it is not probable that the effluent seeps northward and contaminates the beds within the town of Meriden.

The average depth to water in the 44 wells in till that were measured was nearly 2 feet greater than in the wells in drift, being 16.7 feet as compared with 15 feet, and a greater range in depth was also found in the wells in till. Both the least depth (1 foot) and the greatest depth (43 feet) to water in dug wells were noted in wells in till on the hillsides.

Water in sandstone.—A large proportion of the dug wells fail in summer, and hence of late years many of them are being improved by drilling deeper, or else the dug wells are abandoned and drilled wells are sunk to furnish better and more permanent domestic water supplies.

Deep wells have been drilled in the city of Meriden by several industrial concerns, in order to obtain supplies for their factories. In general these wells yield moderate amounts of water, but it is only fair for use in boilers, and the softer surface water of the municipal system has been again utilized for making steam. The chemical character of the water from three of the drilled wells is shown by the analyses of water from wells 7, 41, and 52, given on page 52.

The water from well [illegible] is fairly soft and contains only small amounts of mineral matter in addition to the calcium and bicarbonate radicles, which, combined as calcium bicarbonate, form with the silica the principal constituents of the scale that results from the use of this water in boilers. The water from well 52 contains nearly twice as much mineral solids and is noticeably harder. Well 52 was drilled in [illegible] by the Charles Parker Co. to a depth of 1,000 feet in an attempt to obtain a large supply of water suitable for industrial use. A pumping test of about [illegible] gallons a minute is said not to have overtaxed the well, and the water is used for some purposes in the factory. This well water forms a very hard white scale in boilers, however, and the city water is used for making steam. The analysis shows that in addition to the relatively high calcium and bicarbonate the water contains a rather large amount of scale-forming sulphate.

Five wells drilled in the grounds of the Edward Miller Co. (well group [illegible]) in [illegible] are said to be the first deep wells sunk in Meriden. Three of the wells are 300 feet deep, the other two being respectively [illegible] and [illegible] feet in depth. The deepest well was not successful and has been abandoned. The shallowest well is said to have the greatest yield. It and the three 300-foot wells supply the needs of the factory except for making steam, for which purpose the softer municipal water is used. The amount of well water that is pumped varies according to the factory needs, but a supply of 75,000 to 100,000 gallons a day of [illegible] hours is said to have been obtained at times from the four wells.

The factory of the Meriden Curtain Fixture Co. and the factory of Foster, Merriam & Co. each have a well about 300 feet deep. The well of Foster, Merriam & Co. is said to have a capacity of about 170 gallons a minute, but that of the Meriden Curtain Fixture Co. yields only about 25 gallons a minute. Like the other deep wells of the town, these also yield water that is too hard to be satisfactory for boiler use, but they have supplied other needs of the factories.

The records of the drilled wells in Meriden show that in the sandstone, which throughout most of the town is below the "Anterior" or lowest trap sheet, never-failing domestic supplies can be obtained from wells about 100 feet deep. Supplies of less than 10 gallons a minute are usually developed at this depth, however. The 300-foot wells of the Edward Miller Co. do not seem to have obtained appreciably larger supplies than shallower drilled wells in the town. A 562-foot well drilled by the International Silver Co. did not obtain water that was suitable for their factory needs. The deepest well that was reported is that of the Charles Parker Co. (No. 52). By drilling to 1,000 feet a supply of more than 50 gallons a minute was obtained, but it was not learned whether the main water supply was truck near the bottom of the well in a porous sandstone or whether ; was obtained from numerous joints and crevices in the fairly solid andstone. Although this one well, 1,000 feet deep, is capable of ielding fully 50 gallons a minute, other wells, sunk to equal depth n the sandstone, may not be equally successful in tapping a fairly arge supply of water.

Springs.—A number of springs in Meriden have been developed or domestic use, and water from Redrock, Hillside, and Live Oak prings (Nos. 33, 39, and 68) is bottled and sold locally for table ise. The analyses of water from Hillside Spring (No. 39, p. 52) hows that it has a fairly low total solid content. Calcium and bicaronate, two of the substances that render water hard and form scale n boilers, are the principal constituents in this spring water, as in he well waters of the region. Most of the springs issue directly from the sandstone. Spring 4, however, issues at the base of a steep slope in which trap is exposed, and spring 99 seems to derive its supply from the till-covered slopes above it.

RECORDS OF WELLS AND SPRINGS.

The following lists give data concerning certain wells, scattered throughout the town of Meriden, that are indicated on Plate II and are believed to be typical of their respective localities. Data concerning certain springs are also listed. Several of these springs have been developed commercially, and their waters are locally sold for table use.

Dug wells in Meriden.

Map No.	Topographic position.	Elevation above sea level.	Total depth.	Depth to water May, 1915.	Method of lift.	Remarks.
		Feet.	*Feet.*	*Feet.*		
2	Base of hill	200	22	15	Windmill	Near marshy tract.
5	Lowland	170	12	4	Chain pump	
6	Slope	210	26	15	do	Usually dries in summer. Entire distance in sandstone.
9	do	190	42	35	Wheel and bucket	Entire distance in sandstone.
10	do	170	18	12	Pitcher pump	Never dry.
11	do	180	31	23	Wheel and bucket	Sandstone penetrated.
17	do	210	19	16	Chain pump	
18	Base of hill	280	23	19		Unused.
19	Slope	380	22	20		Do.
21	Base of hill	130	30	19		Unused; dry in summer.
22	Swale	125	22	16		Unused but never dry.
23	do	150	10	9		Unused.
25	Lowland	150	20	17		Do.
26	Slope	170	35	27	Windlass	Dry in summer; sandstone at 15 feet.
27	Lowland	210	24	7	Pitcher pump	150 feet from brook and 14 feet above it.
29	Hilltop	390	35	30	Windlass	Dry in summer.
30	Swale	330	16	11	do	Do.
32	do	300	23	21	do	Do.
35	Hilltop	350	28	13	Chain pump	Dry in summer; most of distance in sandstone.
36	do	350	27	15	Windlass	Never dry.
42	Base of hill	140	12	10	Rope and bucket	Gets low but not dry.
44	Slope	290	30	24	Wheel and bucket	
45	do	300	50	43	do	Dry in summer.

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the principal constit
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Five wells drilled
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Three of the wells a
250 and 350 feet in
has been abandoned
est yield. It and t
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struck near the bottom of the well in a porous sandstone or [illegible] was obtained from numerous joints and crevices in the fairly [illegible] sandstone. Although this one well, 1,000 feet deep, is [illegible] yielding fully 50 gallons a minute, other wells, sunk to [illegible] in the sandstone, may not be equally successful in tapping a [illegible] large supply of water.

Springs.—A number of springs in Meriden have been [illegible] for domestic use, and water from Redrock, Hillside, [illegible] springs (Nos. 33, 39, and 68) is bottled and sold [illegible] use. The analyses of water from Hillside Spring [illegible] shows that it has a fairly low total solid content. [illegible] bonate, two of the substances that render water hard [illegible] in boilers, are the principal constituents in this [illegible] the well waters of the region. Most of the [illegible] from the sandstone. Spring 4, however, issues at [illegible] slope in which trap is exposed, and spring 99 [illegible] supply from the till-covered slopes above it.

RECORDS OF WELLS AND SPRINGS.

The following lists give data concerning [illegible] throughout the town of Meriden, that are [illegible] are believed to be typical of their respective [illegible] cerning certain springs are also listed. Several of [illegible] been developed commercially, and their [illegible] table use.

Dug wells in Meriden.

Map No.	Topographic position.	Elevation above sea level.	Total depth.	Depth to water May, 1915.	Method of lift.	[illegible]
		Feet.	*Feet.*	*Feet.*		
2	Base of hill	200	22	15	Windmill	[illegible]
5	Lowland	170	12	4	Chain pump	[illegible]
6	Slope	210	26	15	do	[illegible]
9	do	[illegible]	42	[illegible]	[illegible]	[illegible]
10	do	[illegible]	18	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	31	[illegible]	[illegible]	[illegible]
17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] adjacent
[illegible] and sold locally; [illegible] noticeably less
[illegible] bottled and sold locally [illegible] p. 52.)
[illegible] protection tank of Edward [illegible]
[illegible] Spring; bottled and sold lo-
[illegible] Elm Spring.
[illegible] watering trough at roadside.
Supplies a pond.
Domestic water supply.
Domestic supply for several houses.
Domestic supply, raised by hydraulic ram.

Dug wells in Meriden—Continued.

Map No.	Topographic position.	Elevation above sea level.	Total depth.	Depth to water May, 1915.	Method of lift.	Remarks.
		Feet.	*Feet.*	*Feet.*		
47	Slope	260	32	22	Wheel and bucket	100 yards south of gravel pit.
48	.....do	310	21	19	.....do	Dry in summer.
51	.....do	160	33	20	Windlass	
53	.....do	290	44	36		Unused.
55	.....do	340	12	4		Do.
56	.....do	350	25	17	Windlass	
57	.....do	350	38	27	.....do	Gets low but not dry.
59	Hilltop	390	43	20	Chain pump	Never dry; sandstone penetrated.
60	Base of hill	270	13	6	.....do	Dry in summer.
61	Slope	390	21	8	Air lift	Gets low but not dry.
62	Knoll	400	19	7	Rope and bucket	Good supply.
63	Slope	260	26	24		Unused.
64	Swale	230	18	15	Windlass	Nearly dry in summer.
65	Slope	170	23	22		Unused.
66	.....do	180	21	15	Pitcher pump	
67	.....do	260	24	18		Unused; dry in summer.
70	.....do	370	5	1	Rope and bucket	Stable supply.
71	.....do	390	33	15	Windlass	Dry in summer.
72	Swale	300	34	27	Chain pump	Do.
77	Lowland	250	16	8	.....do	
78	Slope	270	18	7		Unused.
79	.....do	290	21	6	Windlass	
81	Swale	270	18	10		Used as milk cooler; domestic supply from well No. 80.
82	Base of hill	290	20	13	Chain pump	Dry in summer.
84	Lowland	90	26	21	Wheel and bucket	Never dry.
85	Base of hill	70	28	21	Force pump	
88	Lowland	70	31	24	Wheel and bucket	
91	Slope	90	26	18	Chain pump	
92	.....do	130	11	5	Rope and bucket	
93	.....do	250	25	18	Windlass	
95	.....do	230	20	12	Pitcher pump	Dry in summer.
97	Base of slope	300	27	13	Windlass	
98	Swale	310	25	21	Wheel and bucket	
102	.....do	380	33	23	Pitcher pump	
103	Knoll	260	28	19	Wheel and bucket	Do.
105	Ridge	345	24	9	.....do	Temperature 46° F. Never dry during 65 years.
106	Slope	500	24	18	.....do	Temperature 50° F. Mostly in sandstone.

Drilled wells in Meriden.

Map No.	Topographic position.	Elevation above sea level.	Total depth.	Depth to water May, 1915.	Depth to rock.	Kind of rock.	Yield.	Remarks.
		Feet.	*Feet.*	*Feet.*	*Feet.*		*Gallons per minute.*	
3	Slope	210	50+	15	1	Sandstone		
7	.....do	210	75	20	1	.....do		Mr. Litscher, owner. (See analysis, p. 52.)
8	Lowland	170	42	8		.....do		Dug 20 feet, drilled 22 feet; dry every summer until drilled.
12	Knoll	190	72	15	1	.....do		Drilled about 1885; flowed at first.
13	.....do	190	69	40	1	.....do		
14	Slope	200	72	30		.....do		
15	.....do	220	83	43		.....do		
16	Knoll	230	125	40	1	.....do		
20	Slope	360	124	45	50	.....do		Pump 300 gallons daily.
24	Lowland	150	300	10		.....do		J. D. Bergen Co.; drilled about 1900; too hard for boiler use; used for sprinkling, etc.
28	Slope	290	70	25		.....do		Dug 30 feet; drilled 40 feet.
31	Swale	310	80	22		.....do		Dug 28 feet; drilled 52 feet.

Drilled wells in Meriden—Continued.

Map No.	Topographic position.	Elevation above sea level.	Total depth.	Depth to water May, 1915.	Depth to rock.	Kind of rock.	Yield.	Remarks.
		Feet.	*Feet.*	*Feet.*	*Feet.*		*Gallons per minute.*	
34	Slope	350	79	30	25	Sandstone		Dug 35 feet; drilled 44 feet.
37	do	345	100+	30	5	do		
38	do	260	150	50		do		
40	Lowland	125	562	10±	100±	do		International Silver Co.; too hard for boiler use; stained silverware; formerly used for sprinkling, etc.; abandoned.
41	do	130	152	7	31	do		Thos. F. Lyons Bottling Works; water struck at 50 feet; rose to 7 feet. (See analysis, p. 52.)
43	Slope	170	250-350		6-10	do		Edward Miller Co., drilled 1895; 5 wells 250-350 feet deep. Factory supply.
46	do	280	120	25		do		Dug 32 feet; drilled 88 feet.
49	do	250	205	54		do		Dug 15 feet, drilled 190 feet.
52	do	260	1,000	70		do		Charles Parker Co., drilled 1905; too hard for boiler use; air lift. Factory use. (See analysis, p. 52.)
58	Hilltop	390	200	30		do		
73	Ridge	370	220	30	20	do	12	
74	Slope	330	48	20	12	do		Water struck at 40 feet; rose to 20 feet.
75	Saddle	305	60	30	40	do	4	
76	Slope	300	76	30	43	do	6	
80	do	300	128	15		do		Gas engine and windmill.
90	Lowland	80	90	20		do		Good supply.
94	Slope	245	93	40		do		Windmill.
96	do	290	75	27		do		
100	do	330	102	20		do		Good supply of water struck at 92 feet.
101	Base of hill	320	50	22		do		
104	Ridge	350	70	15		do		

Springs in Meriden.

Map No.	Topographic position.	Elevation above sea level.	Temperature.	Yield.	Bedrock.	Remarks.
		Feet.	*°F.*	*Gallons per minute.*		
1	Slope	180	49	5	Sandstone	Private drinking water supply.
4	Base of hill	180	47	1	Trap	Domestic supply of several adjacent houses.
33	Swale	250		4	Sandstone	Redrock Spring; bottled and sold locally; also dairy supply; flow noticeably less in dry summers.
39	do	190		5	do	Hillside Spring; bottled and sold locally (See analysis, p. 52.)
50	Base of hill	130	45	6	do	Unused.
54	do	290		5±	do	Supplies fire-protection tank of Edward Miller Co.
68	do	250	49	13	do	Live Oak Spring; bottled and sold locally.
69	do	220		1±	do	Live Elm Spring.
83	do	85	49	2	do	Watering trough at roadside.
86	Swale	100		5	do	Supplies a pond.
87	Base of hill	80		5	do	Domestic water supply.
89	Slope	120		3±	do	Domestic supply for several houses.
99	do	290		3±	do	Domestic supply, raised by hydraulic ram.

[illegible]

[illegible] ground waters in the [illegible] wells and one is [illegible]

[illegible] Meriden.

[illegible]

	Drilled wells.			Hillside spring.
	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	Trace.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	4.1
[illegible]	[illegible]	[illegible]	[illegible]	3.0
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	5.3
[illegible]	[illegible]	[illegible]	[illegible]	7.0
[illegible]	[illegible]	[illegible]	[illegible]	6.0
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	Fair.
[illegible]	[illegible]	[illegible]	[illegible]	$CaCO_3$

[a] [illegible] and in table pp. [illegible]

[b] [illegible]

[c] [illegible]

MIDDLEFIELD.

HISTORICAL SKETCH.

The town of Middlefield, which occupies the south-central part of the area under discussion, was settled about 1700 by three families, who took up their homes respectively in the lowland in the southern portion, in the highland in the north, and near the center of the town.

The principal village is at Rock Fall, which had a population of about [illegible] in 1915. Middlefield Center and Baileyville are communities of about [illegible] people each. The remainder of the population resides mainly near Coe Hill in the northern part of the town, and near Middlefield railroad station in the southern part.

The area of the town is about [illegible] acres, according to planimeter measurement on the Middletown and Guilford topographic maps.[1] About 2,700 acres in the town, or nearly one-third of the total area, is wooded. The woodlands are very largely contained in one body covering uplands in the western part of the town, however, and only four or five areas of more than a few acres each are situated in the eastern two-thirds of the town. A large area of marsh occupies the south-central portion of the town, along the valley of Coginchaug

[1] The area is given as [illegible] acres on p. 432 of the Connecticut State Register and Manual for 1915, which probably is exclusive of the water surface.

River, and together with a smaller area in the northeast makes a total of fully 400 acres of marsh land.

Higby Mountain reservoir of the Middletown city water supply is in the northern part of the town, and Laurel Brook reservoir, of the same system, lies mainly within the eastern border. Black Pond (Pl. V, *B*) on the west border, Beseck Lake in the west-central portion, and a power pond in the east make, together with the two reservoirs, a total water surface nearly equal to that of the marsh land.

POPULATION AND INDUSTRIES.

In 1744, when Middlefield community was organized as a parish, it contained about 50 families, or possibly 350 people. At this time the community was given its present name, signifying that it was a rural portion of Middletown. By 1815 the population had increased only to about 450, but in 1866, when the parish was incorporated as a separate town, its population was more than double this number.

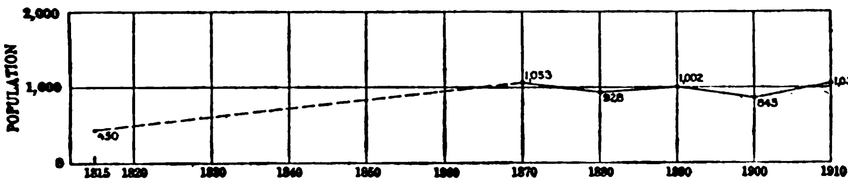

FIGURE 8.—Curve of population of the town of Middlefield, Conn.

Since the incorporation of the town its population has fluctuated somewhat with the activity of factories within its borders, but it has not risen above the figure of the first census after the town was formed. The diagram (fig. 8) shows the fluctuation in population, so far as it is given by the records of the census, taken at 10-year intervals.

The available water power was early utilized by gristmills and other mills, and the manufacture of various small articles was early undertaken. At present factories near Rock Fall and Baileyville produce cording, suspender webbing, and cotton cloth. Other industries in these settlements are the manufacture of gun sights, pistols, and novelties made of ivory and bone.

The greater part of the town is devoted to agriculture. Hay and other field crops are raised on the lower lands, and orchard fruits, especially peaches, are extensively grown in the higher areas. A number of dairy farms have also been established within recent years.

The town is crossed by the Air Line division of the New York, New Haven & Hartford Railroad, which gives direct outlet southward to New Haven and northeastward to Middletown. A trolley line [illegible] to Middlefield Center, and the main [illegible] form a good means of communication with the neighboring settlements.

GEOLOGY.

The town of Middlefield is not traversed by any extensive faults, and the rock structure is therefore simple. The series of Triassic sandstones and [illegible] dips gently eastward, as is shown in the [illegible] of structure section G–H on Plate III [illegible].

In the northwest corner of the town the "Anterior" or lower trap sheet is well exposed [illegible] in the bed of the brook between East Meriden and [illegible] and in a very low ridge at the west side of the road (see Pl. III). This trap sheet is apparently broken and offset by a small fault in the [illegible] corner of the town, for it is there [illegible] by the overlying "Anterior" sandstone, as shown on Plate III. This sandstone forms the uppermost rock along most of the western border of the town, at the base of Higby and Beseck mountains. This northward-trending mountain ridge is formed by the "Main" trap sheet, but this trap dips eastward beneath the "Posterior" sandstone, which forms the uppermost rock through the central part of the town. Eastward this sandstone is succeeded in turn by a band of trap rock of the "Posterior" or upper sheet, which is overlain in the southeastern part of the town by the upper sandstone.

East of the valley of Coginchaug River the upper trap sheet is so far below the surface that it probably would be penetrated only by wells more than 1,000 feet deep. The liability of striking trap rock, which is tough and hard to drill, in wells sunk in the region east of Coginchaug River is therefore remote. The "Posterior" trap sheet, however, immediately underlies portions of Middlefield Center and Rock Fall and the intervening lands, as well as less thickly settled lands to the north and to the south. Wells that are drilled within the area which is shown on Plate III as underlain by the "Posterior" trap will therefore reach the trap immediately beneath the glacial deposits. This trap sheet is 100 to 150 feet thick, but it is probable that by drilling through it into the "Posterior" sandstone, fairly large supplies of water can be developed. The lands underlain by the "Posterior" trap are for the most part lower than the area of "Posterior" sandstone to the west. It seems possible, therefore, that artesian flows can be obtained from this sandstone beneath the confining layer of trap rock at some places in the trap area.

Except along its western border the area of "Posterior" sandstone west of the "Posterior" trap sheet is underlain at depths of

500 to more than 1,000 feet by the "Main" trap sheet. There is therefore little liability that trap will be encountered in wells drilled near Coe Hill and near the outlet of Beseck Lake.

Stratified glacial drift fills the valley of Coginchaug River and the adjacent lower lands, but the greater part of the town is covered by deposits of till. Over the slopes in the southeast the material seems to be fairly thick, and throughout the central portion it forms several drumlin hills. Over Higby and Beseck mountains the till is thin, however, and the trap rock is exposed on their eastern slopes, probably at many points in addition to those indicated on Plate II, as well as in the cliffs that form the western fronts of these ridges.

SURFACE FEATURES.

Middlefield is divided topographically into three fairly distinct belts that trend northward. Along the western side Higby and Beseck mountains constitute a prominent ridge whose crest attains an elevation of about 925 feet on the northwest border of the town. Westward the ridge drops abruptly to rolling land along the edge of the town. Eastward the slope is less abrupt, though steep, to a narrow lowland in part occupied by Beseck Lake and Higby Mountain reservoir. East of this lowland a series of narrow, elongated hills constitutes an area that slopes in the main eastward to the valley of Coginchaug River. The lowest point in the town, where this river crosses the northeastern boundary, lies at an elevation of about 80 feet.

The eastern portion of the town constitutes a gently rolling surface that rises less than 200 feet above the river.

STREAMS.

Coginchaug River drains practically all the town except about 2 square miles in the northwestern part, which is tributary to Higby Mountain reservoir. The Coginchaug has its headwaters in Durham and Guilford towns, several miles south of the Middlefield boundary. For fully half its course through Middlefield it is a sluggish stream, flowing through marsh land half a mile wide. The open valley ends near Middlefield Center, however, and thence eastward the stream has a steeper gradient. The drainage of the west and southwest portions of the town is received by Beseck Lake, which discharges directly eastward to the Coginchaug. In the southeast a portion of the drainage is received by Laurel Brook reservoir. This reservoir overflows northward through Laurel Brook, which joins the Coginchaug half a mile below the Middlefield town line. The drainage basin of Coginchaug River above the northeast border of Middlefield comprises about 33 square miles. The [illegible] that of Quinnipiac River and it has [illegible]. It seems probable, therefore, that the unit runoff from the two basins is approximately the same. On this assumption the discharge of the Coginchaug would appear, by comparison of its drainage area with that of the Quinnipiac and its discharge curve with that of the Quinnipiac (fig. [illegible], p. [illegible]), to be about [illegible] second-feet during the spring high water and [illegible] or 15 second-feet during the summer low-water flow. The daily flow of the Coginchaug and its various tributaries is greatly influenced by mill ponds, however.

A gristmill built near Rock Fall in the eighteenth century, was replaced about [illegible] by a sawmill and below this a fulling mill was constructed shortly afterward. A snuff mill, a powder mill, and other small factories were early established near Rock Fall and near Baileyville. A cotton factory, constructed near the same place in [illegible], was burned in [illegible] and was replaced by a larger structure.

A storage dam was built about [illegible] at the outlet of Beseck Lake by those interested in manufacturing along the lower Coginchaug, and the dam was in later years increased in height. The original pond has thus been greatly increased in size and still furnishes an important supply of water for power development during the lowest stages of Coginchaug River. The drainage area tributary to the lake is about 1,400 acres, of which the lake covers about 35 acres.

GROUND-WATER SUPPLIES.

Water in stratified drift.—So far as was learned by the writer, all the residents in Middlefield obtain their water supplies from individual wells or springs.

In Middlefield only the lowland along the valley of Coginchaug River is covered by stratified drift, and as the larger part of this area is marsh land, few wells have been sunk in it. In the six wells ending in stratified drift that were examined by the writer in May, 1915, the average depth to water was 12 feet, the extreme depths being 7 and 21 feet. (See fig. 3, p. 10). The deepest well is said to fail in summer, but the others yield perennial supplies. An analysis of water from one of the shallowest drift wells (No. 11), given in the table on page 59, shows this water to be comparatively low in total mineral content, calcium and bicarbonate being the chief constituents.

The most promising part of the town for the development of large quantities of ground water is probably in the marshy valley of Coginchaug River, for sandy layers that would yield good supplies to shallow drilled wells, properly screened, probably are present beneath the surficial layers of soil and silt.

Water in till.—The greater part of Middlefield is covered with lacial till, and most of the domestic water supplies are obtained rom wells dug in these unstratified deposits. The average depth water, in May, 1915, in the 27 wells in till that were measured, as 14.3 feet. (See fig. 3, p. 16.) The average depth to water in ells in till on hillsides and in lowlands was only slightly greater han the average depth in the six wells in drift that were observed, ut in several wells in till on the tops of hills and knolls the average epth to water was nearly 21 feet.

The analyses of water from two wells in till (Nos. 6 and 26, p. 59) how larger mineral contents than the water from the well in stratied drift (No. 11), and it is probably true that the waters in the ill as a rule contain more mineral matter than the waters in the tratified drift. This condition is indicated by the average mineral ontents in all the waters of wells in till and drift that were nalyzed. (See table of analyses, p. 59.) The water of well 6 conains rather large amounts of chloride and nitrate, and it is possible hat a portion of these substances is due to contamination by the vastes from the adjacent house. Well 26 is dug beside a house and is situated so that it may receive polluted water both from the kitchen and from the adjacent barnyard. Serious contamination of this sort appears to be shown by the large amounts of chloride and nitrate that were found in the water. This water also is noticeably hard, as it contains relatively large amounts of calcium and bicarbonate.

Water in sandstone and trap.—Five drilled wells were noted in the town in localities where the glacial till is too thin to furnish a reliable water supply. Two of these wells penetrate the "Posterior" trap sheet, their total depths being 60 and 106 feet, and they obtain supplies of soft water sufficient for domestic needs. The other three wells are drilled in sandstone, to total depths of 65, 125, and 150 feet. These wells also yield sufficient water for domestic use, though the capacity of each is probably less than 5 gallons a minute.

Springs.—Three springs (Nos. 4, 15, and 16) were noted in the town. All have slight flow, however, and are little used. Other small springs probably issue on the higher slopes of Beseck and Higby mountains, but no springs were reported to be used for domestic supply.

RECORDS OF WELLS AND SPRINGS.

The following lists contain data concerning certain wells and springs whose locations are indicated on Plate II. They are believed to be representative of the ground-water conditions throughout the town.

[illegible] wells in [illegible]

Well No.	Topographic position.	[illegible]	[illegible]	[illegible]	[illegible]	Remarks.
		Feet.	Feet.	Feet.		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] in summer.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Do.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Do.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Never dry.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Never dry [illegible] encountered. [illegible] owner. See analysis [illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] in summer.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] and [illegible]	Never dry. [illegible] owner. [illegible] p. [illegible]
[illegible]	Top of [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Do.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Do.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Do.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] in summer.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Do.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] feet above [illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Never [illegible] water. [illegible] See analysis, p. [illegible]
[illegible]	Top of [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Never dry.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible] dry in summer.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Never dry.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] pump.	[illegible] and [illegible] feet above it.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Never dry.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Dry in summer.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] never dry.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Never dry.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

[illegible] wells in [illegible]field.

Map No.	Topographic position.	[illegible]	[illegible]	[illegible]	[illegible]	Kind of rock.	Yield.	Remarks.
		Feet.	Feet.	Feet.	Feet.		Gallons per minute.	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9	Trap		Soft water.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		Sandstone		
24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Do.		Good supply.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		Do.	4	

Springs in Middlefield.

Map No.	Topographic position.	Elevation above sea level.	Temperature.	Yield.	Bedrock.	Remarks.
		Feet	°F.	Gallons per minute.		
6	[illegible]	[illegible]	50		Sandstone	Roadside drinking.
15	[illegible]	[illegible]			Trap	Unimproved.
[illegible]	[illegible]	[illegible]			Do.	Do.

ANALYSES OF GROUND WATER.

The following table contains three analyses of ground water in the town of Middlefield. The analyses are discussed on pages 19–21.

Chemical composition and classification of water from dug wells in Middlefield.

[Parts per million. Samples collected May, 1915; S. C. Dinsmore, analyst.]

	Well ending in stratified drift.	Wells ending in till.	
	11[a]	6	26
Silica (SiO_2)	18	26	19
Iron (Fe)	Trace.	Trace.	Trace.
Calcium (Ca)	20	25	118
Magnesium (Mg)	5.6	8.9	37
Sodium and potassium (Na+K)[b]	.0	16	51
Carbonate radicle (CO_3)	.0	.0	.0
Bicarbonate radicle (HCO_3)	48	63	97
Sulphate radicle (SO_4)	10	34	49
Chloride radicle (Cl)	7.0	18	102
Nitrate radicle (NO_3)	12	28	352
Total dissolved solids at 180° C.	101	192	769
Total hardness as $CaCO_3$[b]	73	99	447
Probable scale-forming ingredients[b]	86	110	430
Probability of corrosion[b c]	(?)	(?)	C
Quality for boiler use	Good.	Fair.	Poor.
Chemical character	Ca-CO_3	Ca-CO_3	Ca-NO_3

[a] Numbers at heads of columns correspond to those on map (Pl. II, in pocket) and in table (p. 58.)
[b] Computed.
[c] C—Corrosive; (?)—corrosion doubtful.

MIDDLETOWN.

HISTORICAL SKETCH.

Middletown occupies the central and southeastern portions of the area treated in this report.

The first white settlers established their homes in 1650 in or near the area at present occupied by the city of Middletown, which stands on the site of an Indian village, Mattabesset or Mattabesec, on slopes overlooking Connecticut River. The name Mattabesset is the corruption of a phrase signifying "at the mouth of a large brook." The community was organized in the year following its settlement and was known as Mattabesset until 1653, when the present name was adopted, from the position of the settlement midway between the upper river towns and Saybrook, at the mouth of the Connecticut.

Since the first settlement the population has been concentrated in the city of Middletown, but small communities have also been built up at Westfield, Newfield, and Highland, in the western part of the town, and in the vicinity of Maromas railroad station, in the eastern part.

The town originally included the area that now comprises Chatham and Portland, east of Connecticut River, and also Cromwell, Middlefield and a portion of Berlin. The present area of the town, considering the center of Connecticut River as its eastern boundary, is about [illegible] acres, according to planimeter measurement on the Middletown, Guilford, and Meriden topographic maps.[1] A relatively large part of the town—[illegible] per cent—is wooded, the main wooded area being in the southeast, as shown on Plate IV (in pocket). As in other parts of the State, practically all the trees of the original forest have been cut, and the woods now consist almost entirely of small trees of later growth. About [illegible] acres, or 2 per cent of the area, may be classed as marsh. This area consists largely of land adjacent to Mattabesset River, along the northeast border of the town, but there are also marshy areas of considerable extent near the southern border of the city and in the southern and southeastern portions of the town. The western half of Connecticut River, which is included within the town, constitutes its greatest water body and covers about [illegible] acres. Several ponds and reservoirs cover a total area less than one-third as great, or only about [illegible] acres.

POPULATION AND INDUSTRIES.

In 1673 the entire town of Middletown contained only 52 families, and for the next few decades the growth in population was slow. An actual decrease took place in some years, for the country is rough, markets are distant, and the heavily timbered farm lands offered little inducement to immigration. During the half century preceding the American Revolution, however, the town increased notably in population and in prosperity, owing chiefly to the development of trade with the West Indies, where cotton cloth and other finished products were exchanged for rum, molasses, and tropical goods.

The development of industries and the location of institutions near the original settlement have caused the population of the town to remain concentrated near this place. The city was incorporated in 1784 and, as is shown in figure 9, more than half the total population of the town is within the corporate limits. A considerably greater percentage of the total population than is indicated by the diagrams is located within 2 miles of the city hall, for there are built-up districts to the south and southeast, beyond the city limits.

At the time of the Revolution the city of Middletown had become an important shipbuilding and commercial center, and manufacturing was also becoming important. The first steam-driven factory in the State was built in 1812 by the Middletown Woolen Manufacturing Co.[2] The industrial activity of the city continued to increase

[1] The area is given at 27,287 acres on p. 433 of the Connecticut State Register and Manual for 1915.

[2] Encyclopaedia Britannica, 11th ed., subject Connecticut.

until, in the middle of the nineteenth century, it was one of the principal cities in the State. The development of the rival cities of New Haven, Hartford, and Bridgeport into railroad centers, as well as seaports, gave them a great advantage over Middletown, and beginning about 1850 this city declined in commercial activity for several decades. Within recent years, however, Middletown has shown renewed activity as a manufacturing center. The principal industries at present include the manufacture of pumps and other hydraulic machinery, hardware, automobiles, typewriters, cutlery, and other small articles, and wooden, cotton, rubber, silk, and web goods. Agriculture and dairying are carried on throughout the lower lands of the town. Brickmaking is an extensive industry at Newfield and near Westfield, and feldspar and building stone have been produced in great amounts from pegmatite and granite gneiss in the

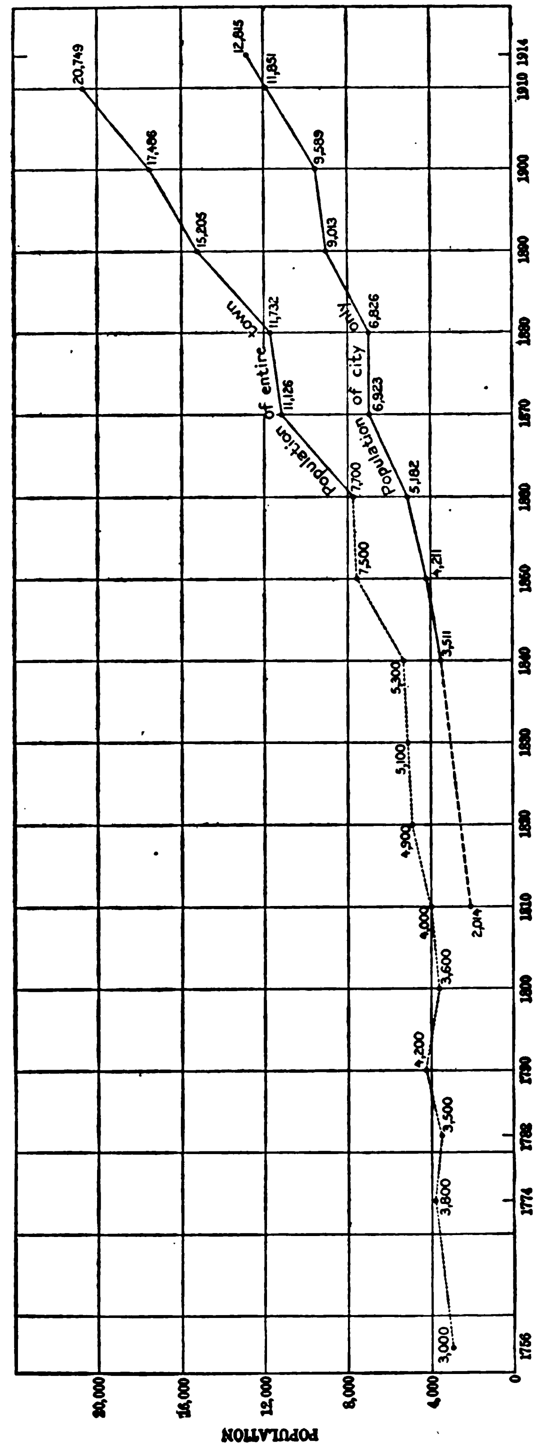

FIGURE 9.—Curves of population of the town and city of Middletown, Conn.

...ver-lead mine" near ... Middletown, is re... Revolutionary War, ... No reports of ... have been obtained

...town is the seat of ... Berkeley Divinity ... Home for Girls is a ... Hospital for the ...

... three well-defined ... or northwest, a ... sandstone, and an ...

... a great fault ... vertically dis... fault zone being ... to the vertical ... have been shoved ... minor faulting ... fault zone. The ... and sand... in pockets). ... Middletown in ... near High... and Higby ... and their ... southwest move... them. ... in addi... rock in two ... in a wider ... the ... bedrock in a ...

... east of the ... town the ... upper sand...

... of Connecticut: U. S. Geol. Survey Eighteenth stones, appear in successive north-south bands, as one proceeds eastward from the west edge of the town. This succession of beds is shown in the middle portion of structure section E–F, Plate III.

The central portion of the town is underlain by the upper sandstone, beneath which the three trap sheets presumably have their usual relative positions. In the vicinity of Staddle Hill the upper surface of the "Posterior" trap sheet is probably about 500 feet below the surface, and at other points nearer the eastern border of the zone of "Posterior" trap, this rock is of course nearer to the surface.

The Triassic rocks dip eastward at an angle that decreases from about 15° to about 10° from the horizontal. This eastward dip probably carries the "Posterior" trap sheet to a depth of 1,500 feet or more below the city of Middletown, provided this upper trap sheet, the thinnest of the three trap sheets, persists as far eastward as the city.

The central area of upper sandstone is bounded on the east by the great fault zone that forms the eastern border of the central lowland of the State. The ancient crystalline rocks east of the fault have been uplifted with respect to the Triassic rocks. No definite contact of rocks of the two classes has been found at any point along the fault zone in Middletown, but the existence of faulting is shown by the presence of crushed, laminated phases of the sandstone in the transition zone from unaltered sandstone to the granite gneiss and pegmatites.

The belt of lowland nearly a mile wide that extends from the city of Middletown nearly to Mattabesset River is covered by stratified drift. Narrower areas of drift also extend up the valleys of Sawmill and West Swamp brooks, and the lowlands along Coginchaug River and along the main branches of Sumner Brook likewise contain deposits of stratified drift. In the lands along the lower portion of Mattabesset River this drift seems, from the records of wells, to be in some places more than 50 feet in thickness. It contains extensive beds of clay that have long been used for brickmaking. Over parts of the lowland the drift is very thin, however, and the underlying bedrock of sandstone or of trap crops out at a number of places, as is indicated on Plate II (in pocket).

The greater part of the town is overlain by deposits of till, though on the higher lands the till is only a few feet thick and the underlying rocks are exposed in many spots. In Lamentation and Higby mountains the lava rock of the main trap sheet that forms these ridges is well exposed in their cliffs. On their eastern slopes the trap is also exposed over considerable areas beneath the very thin covering of till. On these slopes the trap is doubtless exposed in many places a few yards in extent that can not well be shown on a map of the scale of Plate II. Over the highland area in the southeast the till is [illegible] of the granite bedrock and [illegible] of pegmatite are exposed in many places. There are also [illegible] many exposures of the bedrock in [illegible] Plate II.

SURFACE FEATURES.

Middletown has an irregular shape, being bounded on the north and east by streams—the Mattabesset and the Connecticut—and having a large reentrant in the southwest, caused by the incorporation of the former parish of Middlefield as a separate town.

The southeastern portion of the town is occupied by a rugged, hilly area that forms part of the eastern highland of the State. Within the town Bear Hill and Chestnut Mountain are the highest points of this highland, but their respective elevations are only 650 and [illegible] feet. Near its western border the town includes portions of Lamentation and Higby mountains, the highest point in the town being on the crest of Higby Mountain at an elevation of about 925 feet. Between the two hill areas in the east and in the west the surface is rolling or hilly, and the drainage is developed along narrow northward-trending valleys.

There is a wide area of lowland in the northern portion of the town, in the vicinity of Mattabesset River and along its tributary, Sawmill Brook. Near the city of Middletown there are also lowlands to the west along Coginchaug River and to the southeast along the main branches of Sumner Brook. East of the city, along the Connecticut, the slopes come down rather abruptly to the river, but there is a narrow lowland extending westward from Maromas railroad station and a meadow a quarter of a mile wide at the mouth of Hubbard Brook.

STREAMS.

Connecticut River, the master stream of the region, borders the eastern side of Middletown for 9 miles. In this portion of its course the stream has a width of one-eighth to three-eighths of a mile and a depth of channel sufficient for small seagoing vessels. The limit to the draft of ships that traverse the river is chiefly determined by a bar at its mouth, 30 miles below Middletown city. The influence of the tide is felt in the river for a number of miles above Middletown.

The drainage from the different parts of Middletown flows in fairly direct lines to the Connecticut. Mattabesset River, which forms the northern border of the town, receives several northward-flowing brooks that drain the northern and western lands. Sawmill Brook, the principal one, heads near the western boundary of the town. Early in May, 1915, it was carrying nearly 2 second-feet of water in its lower course, but its normal summer flow probably is less than half that amount. A considerable part of its flow also sinks in the lowland near Mattabesset River before uniting with that stream.

The flow of Fall Brook, which joins Sawmill Brook near Westfield, is in large part stored in Higby Mountain reservoir. At the falls of the brook, where it cascades across the main trap sheet near Westfield, it had, in May, 1915, a flow of about 0.5 second-foot, but nearly all this water was absorbed by the gravel of the lowland in the half mile between the falls and Sawmill Brook.

The slopes between Westfield and Newfield are drained by West Swamp Brook, which joins the Mattabesset a mile below Westfield station, and by a brook that enters the main stream one-quarter of a mile above the station. Neither of these streams normally carries more than 0.2 or 0.3 second-foot of water.

Coginchaug River, which flows from the southwest through Middlefield, is ponded both in Middletown and in Middlefield, and its daily flow is greatly affected by the storage or release of water at the mill ponds. On May 5, 1915, the discharge of the Coginchaug 1 mile above its junction with the Mattabesset was 52 second-feet, but its average flow during the six months of low water has been given as about 18 second-feet.[1]

The Coginchaug unites with the Mattabesset in the marsh lands half a mile from Connecticut River. The current of the Mattabesset apparently is so checked by its entrance into the larger, more sluggish stream that it deposits a considerable portion of the sediment carried during freshets. Willow Island seems to have been thus built up in the Connecticut opposite the mouth of the Mattabesset.

Sumner Brook drains the southern portion of Middletown and enters Connecticut River at the eastern border of the city. Its western branch, sometimes called Pameachea Brook, drains only slopes that are within the town, but the eastern branch, early known as Sanseer Brook, rises on the border between Durham and Haddam, 2 miles south of the Middletown boundary. Measurements of the west and east branches short distances above their junction three-quarters of a mile from the Connecticut, on May 5, 1915, showed discharges respectively of 20 and 7 second-feet. Both streams are used for power at storage dams short distances above their junction, and these measurements may represent the approximate amounts of water that are normally used during factory hours. Storage dams at Dooley Pond, on the upper course of the west branch, and at a

[1] Report on the investigation of the pollution of streams, p. 45, Connecticut State Board of Health, Hartford, 1915.

similar reservoirs on the east branch aid in controlling the flow for factory use.

The average low-water flow of Sumner Brook probably is proportional to that of Coginchaug River, which has a total drainage area of about 39.7 square miles and an average summer flow at its mouth of 18 second-feet.[1] The entire drainage area of Sumner Brook is about 12.4 square miles, so its mean summer supply to the storage dams along its branches is presumably 5 or 6 second-feet.

The highland area in the eastern part of the town is drained mainly by brooks that flow eastward to the Connecticut. Hubbard Brook and another stream that crosses the southeast border of the town are the largest of these brooks, but each carried only about three-quarters of a second-foot early in May, 1915.

The northwest portion of the highland is drained by two small brooks, whose headwaters have been dammed to furnish a water supply for the State Hospital at South Farms.

WATER SUPPLIES.

Surface water.—In 1866 the city of Middletown constructed Laurel Brook reservoir for a municipal water supply. This reservoir has a mean depth of 1[illegible] feet and a capacity of 220,000,000 gallons. Its watershed has an area of 1.05 square miles (672 acres). The growth and increased needs of the city rendered the supply from this reservoir inadequate about 1897, and Higby Mountain reservoir was constructed, with a maximum depth of about 27 feet, a capacity of [illegible] gallons, and a drainage area of 2.06 square miles (1,318.4 acres).[1] The total safe daily supply from the two reservoirs, estimated at 2,300,000 gallons, was nearly reached during 1913, it being estimated that in the later part of that year 15,000 people were served, the average daily consumption being 2,000,000 gallons, or 133 gallons per capita. By complete metering of the system and the reduction of all wastes to a minimum, however, it has been estimated that the present supply will suffice for the needs of the moderately growing city for a number of years longer. On the basis of an average daily consumption of 90 gallons per capita and the present rate of growth, the supply has been figured as sufficient until 1940. Beseck Lake is considered by hydraulic engineers to offer an available source when an additional supply is needed.

During the summer months some trouble is experienced from a taste and odor developed by algae in the open reservoirs, but treatment with copper sulphate has very appreciably reduced this un-

[1] Connecticut State Board of Health Rept., p. 45, 1914. See also estimate on p. 37, based on discharge of Quinnipiac River.

avorable condition. The following partial analyses show the eneral quality of water in the two reservoirs. The low figures or dissolved solids and hardness indicate waters suitable for inustrial use and domestic supplies. The water from Laurel Brook eservoir has a higher content of dissolved solids, owing, it is said, o the greater effect of evaporation during this reservoir's longer eriod of use.

Analyses of water from Laurel Brook and Higby Mountain reservoirs.[a]

[Parts per million.]

Dates of collection of samples.	Total residue.		Chloride radicle.		Hardness.	
	Laurel Brook.	Higby Mountain.	Laurel Brook.	Higby Mountain.	Laurel Brook.	Higby Mountain.
ugust, 1889, to June, 1891	42	....	2.3	....	18	....
ebruary, 1909, to September, 1910	57	54	3.0	2.8	31	25
uly, 1912, to March, 1913 (Laurel Brook), and July, 1913 (Higby Mountain)	63	51	4.9	2.4	31	24

[a] From report of a consulting engineer. Name of analyst not given.

In 1880 a 2,500,000-gallon impounding reservoir was constructed on a branch of Pameachea Brook by an earthen dam 300 feet long, as a water supply for the State Industrial Home for Girls. One or more drilled wells on the grounds have within recent years augmented this surface-water supply.

The State Hospital for the Insane, situated at South Farms, is supplied by five storage reservoirs, as shown on Plate IV (in pocket). Three mains, 6, 8, and 16 inches, respectively, in diameter, conduct the water to the grounds. The two reservoirs that are not thus directly connected contain additional storage supplies that can be turned into the adjacent reservoirs.

The only other surface-water supply reported in the town is a system that pumps water from Laurel Brook to a private estate on a knoll one-third of a mile west of Long Hill.

The available records indicate that in 1915 about 15,000 people were supplied from the Middletown municipal water system and about 3,000 from the systems of the Industrial School and the State Hospital.

As is shown in the preceding paragraph, about 18,000 people, or 82 per cent of the entire population of Middletown, are supplied with surface water. The remaining 4,000 people depend on individual wells and springs.

Water in stratified drift.—The areas of stratified drift in the northwestern part of the town are to a large extent underlain by clay, and although supplies of water sufficient for domestic purposes may be obtained, the fine-textured sediments do not readily yield water. Detailed study of the stratified drift as a water bearer was not made, but so far as was observed it seemed that the stratified deposits in the valley of the main branch of Sumner Brook were more sandy than in the areas farther west and north and offered the most favorable conditions for the development of ground water on a large scale for industrial or municipal use.

The average depth to water early in May, 1915, in the 21 dug wells that obtain water from the stratified drift was 13.1 feet (see fig. 3, p. 16), but the water level ranged in individual wells from 3 feet in a hillside well to 26 feet in a well in the lowland.[1] Only one of these wells (No. 20) is said to go dry in summer.

Water in till.—As the greater part of the town is covered by deposits of till, the majority of the domestic wells obtain supplies from this material. There is marked difference in the depth to water in different wells, owing to the diversity in the surface features of the town, which includes crystalline highlands thinly covered with till in the southeast, sandstone hills in the south, and trap ridges in the northwest, as well as rolling lands more deeply covered with till throughout the central portion. The extremes of water level in the 55 wells in till that were measured were 2 and 36 feet, both extremes being in wells on slopes. The average depth to water in the hillside wells in till was 16.1 feet, early in May, 1915, and 10.3 feet and 12.3 feet, respectively, in wells in lowlands and on hilltops. The fact that the shallowest average depth in wells in till was on hilltops may have been because the relatively thin layer of till and consequent shallow depth to bedrock on the higher lands kept the water table nearer the surface than in localities where the till is thick.

Water in bedrock.—Many of the wells in till go dry in summer, and in localities where these glacial deposits are too thin to furnish reliable water supplies, wells drilled into the bedrock have of late years come into favor. The 16 drilled wells that were noted in the town (see p. 71) range from 57 to more than 200 feet in depth, averaging about 113 feet, and the average depth to water in May, 1915, was about 25 feet. One well (No. 102) furnishes water at the rate of about 20 gallons a minute. So far as was learned, the other drilled wells have smaller capacities, though careful pumping tests might show that they are capable of yielding more than the amounts with which their owners credit them. The lower half of one well (No. 24) is drilled in the "Main" trap sheet but furnishes a supply of about 5 gallons a minute from this rock. The trap here is probably fractured and fissured to a greater extent than usual, as the locality is

[1] In the preparation of figure 3 Middletown dug wells Nos. 17, 70, 72, and 84 were omitted, for they obtain water from the sandstone.

close to one of the largest faults or breaks in the rock structure. (See Pl. III, in pocket.)

The quality of water in the drilled wells is indicated by the analyses of water from three of them included in the table on page 72. They are waters of moderate mineral content, in which the principal constituents are the usual calcium and bicarbonate. These constituents are largely responsible for the rather high hardness of the waters. This hardness would be somewhat objectionable in washing, for soap would be wastefully consumed, and in steam-making, for the formation of scale would gradually lower the efficiency of the boilers and eventually necessitate cleaning them.

Springs.—Several springs in Middletown furnish domestic water supplies, and in 1915 water from three of them (Nos. 35, 37, and 87) was sold locally for table use. Two other springs (Nos. 27 and 103) also were formerly developed commercially. Water from a spring near the southwest border of the town has long been piped southward as a supply for the village of Durham, but in 1915 the spring was not accessible to the writer. The analyses of three of the spring waters given on page 72 show that they contain notably less mineral matter in solution than the average well waters, but the principal dissolved substances in the springs also are calcium and bicarbonate.

RECORDS OF WELLS AND SPRINGS.

The following lists of wells and springs through the town are believed to represent typical conditions in their respective vicinities. The locations of the several wells and springs are indicated on Plate II.

Dug wells in Middletown.

Map No.	Topographic position.	Elevation above sea level.	Total depth.	Depth to water May, 1915.	Method of lift.	Remarks.
		Feet.	*Feet.*	*Feet.*		
2	Slope	240	38	33	Hand pump	Dry in summer; sandstone penetrated.
3	.....do	105	27	12	Rope and bucket	
4	.....do	40	29	17		Unused.
5	.....do	230	18	9	Chain pump	Dry in summer.
6	.....do	150	38	29	Wheel and bucket	Never dry.
7	Swale	140	21	13	Windlass	Dry in summer.
8	Slope	110	24	20	.....do	Do.
9	Lowland	25	13	10	.....do	
10	Base of hill	225	15	12	.....do	Do.
12	Swale	230	15	9	Pitcher pump	Supplies horse trough; sandston penetrated.
13	Slope	150	14	10	Hand pump	Dry in summer; trap penetrated.
14	.....do	145	16	3	.....do	Never dry.
15	Saddle	210	15	9	Chain pump	
17	Slope	210	30	25	Windlass	Dry in summer; sandstone below 6 feet.
19	Knoll	60	16	9	.....do	
20	Slope	220	21	12	Rope and bucket	Dry in summer.
21	.....do	120	29	23	Wheel and bucket	Never dry.
22	Flat	45	23	7	Windlass	

[illegible]—Continued.

No.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Remarks.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Never dry.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] dry in summer.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Windlass	Never dry.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Do.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] have city water.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Windlass	Never dry.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Do.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] in summer.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Never dry during [illegible] years; supplies [illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Windlass	Seldom dry.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Dry in summer.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Chain pump	[illegible] in summer; have city water [illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	do	Never dry.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Windlass	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	do	Never dry; used as milk cooler; have [illegible] water.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	do	Never dry.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Unused.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Rope and bucket	[illegible] used as milk cooler.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Windlass	Not dry during 3 years.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Dry in summer.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	do	Dry in summer; 300 yards from No. [illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	do	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Chain pump	Never dry; last [illegible] feet in sandstone.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Windlass	Never dry; supplies 4 families.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Chain pump	Dry in summer.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Windlass	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	do	Gets low but not dry.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	do	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	do	Gets low but not dry; last 12 feet in sandstone.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	do	Last [illegible] in sandstone.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	do	Gets low but not dry.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Chain pump	Dry in summer.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Windlass	Spring No. [illegible], which is 100 yards [illegible], furnishes drinking water.
77	[illegible]	[illegible]	[illegible]	[illegible]	Rope and bucket	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	do	Gets low but not dry.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Windlass	Do.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Rope and bucket	[illegible] feet south of brook. Pegmatite exposed.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Windlass	
82	[illegible]	[illegible]	[illegible]	[illegible]	do	Never dry.
[illegible]	[illegible]	[illegible]	[illegible]	24	Hand pump	Dry in summer. 300 feet from No. 82.
84	[illegible]	[illegible]	[illegible]	24	Windlass	Small supply; gets low but not dry; last [illegible] feet in sandstone.
[illegible]	[illegible]	[illegible]	27	12		Unused; have city water.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Windlass	Never dry.
[illegible]	[illegible]	[illegible]	17	[illegible]	Chain pump	
[illegible]	[illegible]	[illegible]	25	17	Windlass	
[illegible]	[illegible]	[illegible]	5	4	Rope and bucket	
[illegible]	[illegible]	[illegible]	15	12	Windlass	Dry in summer.
97	[illegible]	[illegible]	14	[illegible]	do	Do.
[illegible]	do	[illegible]	9	2	Rope and bucket	
[illegible]	do	410	8	6	do	At border of small marsh; 200 feet from No. 98.
100	[illegible] of hill	220	32	15	Chain pump	Never dry.
101	[illegible]	210	18	10		Unused; 125 feet from and 12 feet below No. 100.
[illegible]	do	200	16	11	Windlass	
[illegible]	do	[illegible]	18	2	Hand pump	At base of large pegmatite ledge.
[illegible]	Slope	[illegible]	12	6	Windlass	
[illegible]	do	120	13	11	Chain pump	
[illegible]	Ridge	170	13	7	do	
111	do	160	14	3	Rope and bucket	In small marshy area.

Drilled wells in Middletown.

Map No.	Topographic position.	Elevation above sea level.	Total depth.	Depth to water May, 1915.	Depth to rock.	Kind of rock.	Yield.	Remarks.
		Feet.	*Feet.*	*Feet.*	*Feet.*		*Gallons per minute.*	
1	Slope	130	112	30		Sandstone		
11	Base of hill	225	129	15		....do	4	John B. Vadney, owner. (See analysis, p. 72.)
16	Slope	210	90	25		....do		At Westfield school. (See analysis, p. 72.)
18	....do	220	90	30		....do		Good supply.
24	Base of knoll	280	65	15	30	Trap	5	
33	Slope	410	101	34	50	Sandstone	4	Windmill.
42	Knoll	470	200+	16		....do		Drilling in dug well that dried; 1 gallon a minute at 35 feet, but no other supply down to 200 feet.
49	Slope	100	150	30	55	....do		
57	Knoll	150	98	20		....do		
61	Slope	170	115	35	100±	....do		
63	....do	210	86	20	17	....do	8	
86	Knoll	220	120	20		....do		Small supply.
90	Swale	270	230	20	18	....do	8	Windmill.
92	Base of hill	200	57	20	10	....do	7	
102	Base of ridge	140	70	30		....do	20	Supplies dairy of 50 cows; gas engine.
104	Slope	200	100	30	3	....do		E. E. Harvey, owner. (See analysis, p. 72.)

Springs in Middletown.

Map No.	Topographic position.	Elevation above sea level.	Temperature.	Yield.	Bedrock.	Remarks.
		Feet.	*°F.*	*Gallons per minute.*		
27	Swale	220		2±	Sandstone	Highland Spring. (See analysis, p. 72.)
29	Slope	240			....do	Domestic supply.
31	....do	300	50	1	....do	Supplies roadside watering trough.
35	....do	160		(a)	Trap	Crystal Spring; bottled and sold locally.
37	Base of knoll	120		2	Sandstone	Beech Spring; domestic supply, also bottled and sold locally. (See analysis, p. 72.)
59	Slope	120	49	2	....do	Whitmore Spring; in small marshy area; domestic supply.
66	....do	180			Gneiss	Domestic supply.
69	....do	250			Sandstone	Unused.
71	Swale	170	51	2	....do	75 feet west of brook; roadside drinking spring.
75	Slope	140			....do	Domestic supply.
87	Base of low ridge.	140		16½	....do	Oak Spring; bottled and sold locally. (See analysis, p. 72.)
93	Slope	160		½	....do	Hubbard Spring; domestic supply and roadside watering trough; flow noticeably less in summer.
94	....do	220			....do	Domestic supply.
103	Base of slope	150	50	3	....do	Mountainview Spring; unused; formerly bottled and sold locally.
110	Slope	160	48	½	Gneiss	Unused.

[a] Slight.

ANALYSES OF GROUND WATER.

In the following table are given three analyses of water derived from drilled wells and three of water derived from springs in Middletown. The analyses are discussed on pages 19–21.

Chemical composition and classification of water from wells and springs in Middletown.

[Parts per million. Samples collected May, 1915; S. C. Dinsmore, analyst.]

	Wells.			Springs.		
	11 [a]	16	104	27	37	87
Silica (SiO_2)	15	16	20	16	19	15
Iron (Fe)	Trace.	Trace.	Trace.	Trace.	Trace.	.20
Calcium (Ca)	28	33	41	22	21	23
Magnesium (Mg)	14	19	19	7.2	5.6	4.1
Sodium and potassium (Na+K) [b]	.6	.7	8.5	.0	.0	.0
Carbonate radicle (CO_3)	.0	.0	.0	.0	.0	.0
Bicarbonate radicle (HCO_3)	117	148	219	70	65	46
Sulphate radicle (SO_4)	11	10	9.0	8.6	Trace.	16
Chloride radicle (Cl)	7.0	11	7.0	3.0	6.0	4.0
Nitrate radicle (NO_3)	14	18	.0	.0	14	8.0
Total dissolved solids at 180° C.	159	187	213	96	102	99
Total hardness as $CaCO_3$ [b]	127	160	180	84	75	74
Probable scale-forming ingredients [b]	120	140	170	93	90	90
Probability of corrosion [b, c]	(?)	(?)	N	(?)	(?)	(?)
Quality for boiler use	Fair.	Fair.	Fair.	Good.	Good.	Good.
Chemical character	Ca-CO_3	Ca-CO_3	Ca-CO_3	Ca-CO_3	Ca-CO_3	Ca-CO_3

[a] Numbers at heads of columns correspond to those on map (Pl. II, in pocket) and in table (p. 71).
[b] Computed.
[c] N=noncorrosive; (?)=corrosion doubtful.

ROCKY HILL.

HISTORICAL SKETCH.

The town of Rocky Hill forms the northeast corner of the area discussed in this paper. It embraces the land that lies between Connecticut River on the east and Mattabesset River on the west, and between the towns of Newington and Wethersfield on the north and of Cromwell on the south.

The name Rocky Hill first appears in the records of Wethersfield in 1649, and a grant of land at Rocky Hill was made to Samuel Boardman in the same year. Historical records indicate that a small community existed at Rocky Hill in 1680, the immigrants being the sons of settlers in Wethersfield who started a new community at the convenient landing place 4 miles farther south, on the west bank of the Connecticut, where the river swings over to the base of the rocky hill from which the town is named. It is probable that not more than half a dozen families constituted the first settlement, and it was not until 1720 that it was organized as a parish of the town of Wethersfield. The name "Stepney Parish" was adopted in 1723, but the local name of Rocky Hill clung to the community, and this name was formally adopted in 1826.[1] The present town was incorporated from Wethersfield in 1843. The original settlement has remained the principal village, but the population has also spread along the main highway extending to the north and to

[1] The hill has been locally known as Shipmans Hill, from the tavern of Samuel Shipman, early built at its western base.

the south, and a number of farmhouses also dot the western portion of the town.

The area of the town, taking its eastern boundary as the center of Connecticut River, is about 9,100 acres, according to planimeter measurement on the Middletown topographic map.[1] About 240 acres of this total is covered by the river surface, however. There are only three or four small ponds in the town, and their combined area is only 10 or 15 acres, but four areas of marsh in the northern part, near the headwaters of small brooks, cover a total of about 120 acres. About 23 per cent of the town, or 2,100 acres, is wooded. (See Pl. IV, in pocket.) The woods occupy lands that are chiefly in the southern and eastern portions of the town. These wood lots have been repeatedly cut over, so that very few large trees are left.

POPULATION AND INDUSTRIES.

Shipbuilding and maritime commerce, to which the parish had access through Connecticut River, early became the principal industries. In 1779, during the industrial depression caused by the Revolution, the parish had a population[2] of 881, and during the succeeding 30 or 40 years it developed, chiefly as a shipbuilding center, until it probably had greater industrial importance than it has at present. About 1820 shipbuilding at Rocky Hill began to decline, owing to its more favorable development at other river points, and since that time the population of the town has not changed much. The normal increase due to excess of births over deaths has been about balanced by the excess of those who have moved away over the number of newcomers. The maximum population was reached in 1872–1874, immediately after the construction of the New York, New Haven & Hartford Railroad through the town. This development led to an increase of perhaps 150 in the number of inhabitants, but within a few years this temporary gain was lost. Although the population has remained nearly stationary, its character has changed considerably in the last half century, owing to the emigration of the descendants of the English settlers and the incoming of an increasingly large proportion of Irish. Figure 10 shows the population of the town for the periods for which the figures are available.

Transportation by water on Connecticut River and by rail over the Valley division of the New York, New Haven & Hartford Railroad, which traverses the western border of the river valley, afford easy outlet for produce. A trolley line also gives frequent service between Rocky Hill village and other settlements to the north and to the

[1] The area is given as 9,111 acres on p. 444 of the Connecticut State Register and Manual, 1915.

[2] Stiles, H. R., History of ancient Wethersfield, Conn., p. 952, New York, 1904.

south. The main highway, paralleling the trolley line, is metaled and also affords easy transportation to and from the principally settled portions of the town.

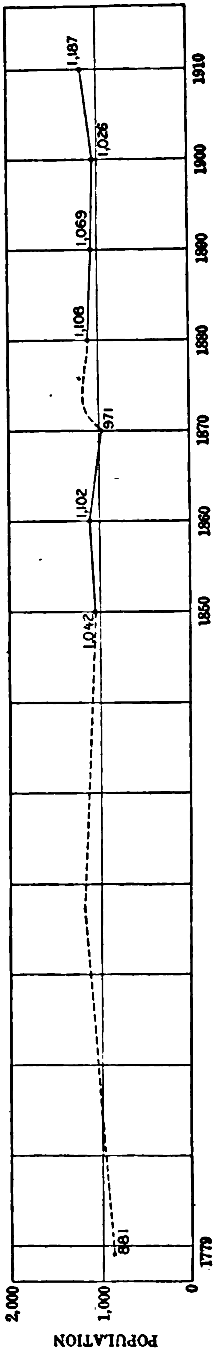

FIGURE 10.—Curve of population of the town of Rocky Hill, Conn.

Since the decline of shipbuilding the chief manufacturing industries in the town have been the making of machinery and of iron castings and forgings. Agriculture and dairying probably are the chief industrial pursuits in the town, however. The northeastern part, between Goff Brook and Connecticut River, is meadow land that is too moist for the successful raising of crops other than the native grasses, but the greater part of the remainder of the town is tilled. Corn and hay are staple crops, though a considerable acreage in the southern portion is devoted to tobacco growing.

GEOLOGY.

Both of the great faults that traverse the region in a southwesterly direction cross the town of Rocky Hill. The eastern fault crosses only the southeast corner of the town, but the western fault extends through its central portion. Several minor faults also displace the rock beds, and the structure within the town is complex. From the northwest portion of the town the successive Triassic rock beds, from the "Main" trap sheet upward to the upper sandstone, inclusive, form the surficial rock eastward through the northern portion of the town. Southeastward, however, the series of beds is traversed before the western of the two major fault zones is reached, and east of this zone the beds above the "Main" trap sheet are repeated. (See Pl. III.)

The most remarkable feature of the bedrock structure is the manner in which the rocks have apparently been rotated by horizontal movement along the major faults, so that in the block between these two great zones of displacement the exposed belts of "Posterior" trap are swung far from the normal north and south trend. The surficial distribution of the several members of the Triassic system that has resulted from the faulting is shown on Plate III (in pocket), and the method by which the faulting has accomplished this distribution is in part indicated by structure section A–B, on the same plate.

The lower lands in the town are covered by stratified glacial drift. Near Mattabesset River, in the southwest corner of the town, and along the branches of Goff Brook, in its northern portion, the stratified deposits are not very prominent, but in the south and southeast they form a sand plain that has an elevation of about 180 feet above sea level. The method of formation of this plain is not clearly understood, but it was probably produced by water from the glacial ice front at a period when the main front of the ice sheet was just north of it and the drainage southward was partly obstructed by glacial débris and remnants of the ice sheet in the lower valley of the Mattabesset and of the Connecticut at Middletown.[1]

The central and western portions of the town are covered by unstratified glacial deposits or till. On the higher hills this material appears to be thick, and some of the hilltops probably are drumlins, but over much of the surface the till is very thin, and the underlying rock is exposed in many road cuts and small cliffs, as is indicated on Plate II.

SURFACE FEATURES.

The most prominent natural feature in the town is the ridge that extends northwestward from the village of Rocky Hill nearly to the town line. It is formed by the "Posterior" or upper trap sheet, which also forms the bedrock immediately below the glacial deposits in other portions of the town. (See Pl. III, in pocket.) Eastward from this rocky ridge a wide, flat meadow only slightly above sea level, extends to Connecticut River. South and west from the ridge the surface is rolling or hilly. In the north-central part of the town the general rolling surface is modified by small marshy areas, and in the south-central portion a sand plain, which continues southward into Cromwell, forms a considerable area of level land.

Although the ridge known as Shipman Hill, near Rocky Hill village, is the most prominent surface feature in the town, it is not the highest, for the slopes on the northwest border reach an elevation of about 310 feet, or fully 100 feet higher than the ridge. Most of the hilltops throughout the rest of the town also attain elevations between 200 and 300 feet. The relief of all these other hills is considerably less, however, as Shipman Hill rises practically from sea level to a height of 200 feet. The lowest portion of the town is of course along Connecticut River, where the influence of the tide is felt.

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[1] Loughlin, G. F., The clays and clay industries of Connecticut: Connecticut Geol. and Nat. Hist. Survey Bull. 4, p. 24, 1905.

STREAMS.

The western portion of Rocky Hill, comprising about 2,775 acres, or 30.5 per cent of the total area, drains southwestward to Mattabesset River through three or four small brooks that rise in the town. The largest of these brooks has its course entirely within Rocky Hill and joins the Mattabesset three-eighths of a mile above the southwest corner of the town. Its basin has an area of about 1,250 acres and its normal discharge is perhaps half a second-foot. In the last half mile of its course the stream flows through lowlands and in no portion of its course does it offer possibilities of development of power. The greater part of the remainder of the town is drained by several branches of Goff Brook, which first flows northward across the town line and then returns, flowing southeastward along the eastern base of Shipman Hill to the Connecticut. Throughout most of its course it is a sluggish stream, and it is affected by the tide for its last mile or more. The meadow area that forms the northeast part of the town has no well-defined drainage channels other than Goff Brook, and the precipitation on this land finds its way to the Connecticut, either directly or by way of the brook, chiefly through seepage. The southeastern part of the town is drained by two streams. Hog Brook flows northeastward and enters the Connecticut on the southern border of Rocky Hill village. Although this brook usually flows throughout the year, in May, 1915, it was a stream only a foot wide and an inch deep, in its lower course. Dividend Brook drains the area farther south. It rises in the south-central part of the town at the northwest border of the sand plain, and after flowing east for 1¼ miles it turns southward and continues in this direction across the town line before swinging sharply northeast back into Rocky Hill. From the town line it continues northeastward to the lowland along the Connecticut. About three-eighths of a mile above its mouth Dividend Brook falls over a small ledge. A gristmill was built at this site in 1669, and the small available water power has nearly ever since been used by mill or factory.

WATER SUPPLIES.

Water in glacial deposits.—The domestic water supply throughout the town is obtained from individual wells and from a few springs.

Stratified drift covers the extensive meadow in the northeast corner of Rocky Hill, the sand plain in the southern portion, and the lower lands along its eastern, northern, and western borders. The northeastern area is too wet for habitation or cultivation, as water stands nearly at the surface over the greater part of it. This land could be improved by drainage, and it could doubtless furnish large amounts of shallow ground water, but the water from this saturated land may be of unsuitable quality for many purposes. The depths to water in four wells (Nos. 40, 41, 42, and 43) in the sand plain in the southern part of the town indicate that the ground-water level deepens eastward, toward the main channel of Dividend Brook, in the same way that in the southward continuation of the plain in Cromwell the underground drainage is toward the main surface stream. In the other drift-covered portions of Rocky Hill few records of dug wells were obtained, but the shallower water levels seem in general to be found on the lower slopes. The average depth to water in the 10 drift wells measured in May, 1915, was 13 feet (see fig. 3, p. 16), or slightly less than the average depth to water in all drift wells observed in the six towns that were studied.

In the till-covered portions of Rocky Hill the depth to water was measured in 22 dug wells that obtain water from this material. Dug well 28 has been omitted because it probably obtains water from trap rock. The depth in May, 1915, ranged from 7 to 21 feet, both the maximum and minimum depths to water being approximated in individual wells on hilltops, on slopes, and in lowlands. The average depth to water in the 22 wells was 13.7 feet, as compared with 13 feet in the measured wells of the town that end in drift.

Water in sandstone and trap.—Many of the dug wells, especially those sunk in till, go dry in summer. Within recent years, therefore, deeper wells have been put down by drilling machines at a number of places. These drilled wells yield unfailing supplies of water, though the capacity of some of them is very small. Two of the 11 drilled wells that were observed yield small artesian flows. One of these (No. 5) is only 55 feet deep, and only the lower 9 feet is in sandstone, from which rock a flow of half a gallon a minute is obtained. The artesian pressure is very probably due to the chance intersection of a favorable arrangement of fissures in the rock and not to an extensive artesian condition; for in well 4, only 200 or 300 yards to the north, little or no artesian pressure was encountered. Well 23, drilled to a depth of 65 feet in the trap at the southern end of Shipman Hill, has an artesian flow about equal to that of well 5. The artesian pressure in well 23 is apparently furnished by water in fissures in the trap that compose the hill, and the well is doubtless supplied by water that reaches it along the system of fissures and crevices in the trap. The following analysis of water from this well shows that it is noticeably more highly mineralized than the usual shallow-well waters of the region. Calcium, magnesium, and bicarbonate predominate, but the chloride and nitrate constituents are also higher than the average and indicate the possibility of contamination.

Chemical composition and classification of water from drilled well 23 at Rocky Hill.

[Sample collected May, 1915; S. C. Dinsmore, analyst.]

	Parts per million.
Silica (SiO_2)	23
Iron (Fe)	Trace.
Calcium (Ca)	58
Magnesium (Mg)	32
Sodium and potassium (Na+K)[1]	7.0
Carbonate radicle (CO_3)	.0
Bicarbonate radicle (HCO_3)	251
Sulphate radicle (SO_4)	8.6
Chloride radicle (Cl)	36
Nitrate radicle (NO_3)	32
Total dissolved solids determined at 180° C	367
Total hardness as $CaCO_3$[1]	276
Probable scale-forming ingredients[1]	250
Probability of corrosion[1,2]	(?)
Quality for boiler use	Poor.
Chemical character	Ca-CO_3

Another well (No. 12), drilled at the base of Shipman Hill, penetrated the trap sheet and draws part of its water from the underlying sandstone. This well, by means of an electrically operated pump and a small storage tank on the hillside, supplies water to six families near by.

Springs.—Two springs (Nos. 26 and 44) were noticed in Rocky Hill that are used for domestic supply. Each issues near a stream channel from the mantle of stratified drift overlying the sandstone, and though their yields are small they are said to be perennial. No other springs were seen in the town, but similar ones probably issue near the courses of other brooks.

RECORDS OF WELLS AND SPRINGS.

Data concerning a number of wells and springs in the town of Rocky Hill are given in the following table. The locations of these sources of water are indicated on Plate II. The wells listed are believed to be typical of those in the several portions of the town.

[1] Computed.

[2] (?)=corrosion doubtful.

Dug wells in Rocky Hill.

Map No.	Topographic position.	Elevation above sea level.	Total depth.	Depth to water May, 1915.	Methods of lift.	Remarks.
		Feet.	*Feet.*	*Feet.*		
1	Knoll	220	22	18	Rope and bucket	Dry in summer.
2	Swale	210	15	8	Bucket	Dry in dry summers; 150 feet from and 6 feet above small pond.
6	Slope	130	14	11	Windlass	
8	.....do	110	18	15	.....do	Dry in summer; sandstone penetrated.
10	Base of hill	110	18	12	.....do	
11	.....do	110	17	12		Unused.
13	Slope	170	28	20	Windlass	
14	.....do	200	22	18	.....do	Dry in summer.
15	.....do	210	23	16	Chain pump	Sandstone penetrated.
17	Base of hill	200	23	19	Windlass	Dry in summer.
18	Slope	220	28	21	Wheel and bucket.	
19	.....do	210	23	15	Windlass	180 feet northeast of well No. 18 and 6 feet lower.
20	.....do	180	16	11	.....do	Dry in summer.
21	Knoll	165	18	15	.....do	
22	Slope	120	11	7	Chain pump	
24	Ridge	150	26	15	Windlass	
25	Slope	110	12	5	.....do	Dry in summer; better water obtained from spring No. 26, 200 feet northwest.
27	.....do	170	18	13	Chain pump	Dry in summer.
28	.....do	175	11	7	.....do	In trap; barnyard supply; 200 feet from No. 29.
29	.....do	170	14	9	Windlass	Low in summer; used mainly as a milk cooler.
30	.....do	190	27	7	Chain pump	Sandstone penetrated.
32	Base of hill	190	18	12	Windlass	Never dry. Trap quarry 400 feet south; also on east side of road.
33	Saddle	250	27	7	.....do	Dry only once in 53 years.
34	Swale	160	11	8	Chain pump	Dry in summer.
35	Slope	150	17	11	Windlass	
36	.....do	170	22	20	Chain pump	Never dry.
38	.....do	50	19	18	Hand pump	Gets low but never dry.
40	Flat	170	16	13	Windlass	
41	Swale	150	14	12	Chain pump	Never dry; 175 feet from and 13 feet above brook.
42	Flat	170	40	14	Hand pump	Formerly dry in summer; drive point in bottom of well gives good supply.
43	.....do	165	30	20	Windlass	Dry in summer.
45	Slope	180	18	15	.....do	Never dry; also supplies neighbors.
46	.....do	170	25	15	Wheel and bucket.	

Drilled wells in Rocky Hill.

Map No.	Topographic position.	Elevation above sea level.	Total depth.	Depth to water May, 1915.	Depth to rock.	Kind of rock.	Yield.	Remarks.
		Feet.	*Feet.*	*Feet.*	*Feet.*		*Gallons per minute.*	
3	Slope	200	97	16		Sandstone		Dug 20, drilled 77.
4	Low ridge	80	41	20	40	.....do		Ample domestic supply.
5	.....do	75	55	0	46	.....do	½	Flows.
7	Slope	130	120	30				
9	.....do	110	100	30	16	Sandstone	25	Supplies 180 cows, 16 horses, and several families.
12	Base of hill	110	98	15		Through trap into sandstone.	7	Supplies 6 families; electrically operated pump.
16	Slope	210	40	11		Sandstone		Dug 17, drilled 23; good supply.
23	Base of hill	30	65	0		Trap	½	Flows; domestic supply and horse trough. Frank Holmes, owner. (See analysis, p. 78.)
31	Slope	190	150	15		Sandstone		Windmill.
37	.....do	180	125	20		.....do	1½	
39	Swale	110	75	45		.....do		Small supply.

3 sheets
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3 Sheets
5-4-94

449 PLATE II

DEPARTMENT OF THE INTERIOR
FRANKLIN K. LANE, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

WATER-SUPPLY PAPER 450—A

GEOLOGY AND WATER RESOURCES OF THE GILA AND SAN CARLOS VALLEYS

IN THE

SAN CARLOS INDIAN RESERVATION, ARIZONA

BY

A. T. SCHWENNESEN

Contributions to the hydrology of the United States, 1919
(Pages 1-27)

Published November 10, 1919

WASHINGTON
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1919

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By A. T. SCHWENNESEN.

INTRODUCTION.

In recent years the Indian farmers in the valleys of Gila and San Carlos rivers, in the San Carlos Indian Reservation (Pl. I and fig. 1), have been seriously handicapped by an inadequate supply of water for irrigating their crops. A shortage of water at times when it is most needed has tended to discourage those Indians who are making an earnest effort to farm and has done much toward neutralizing the efforts of the reservation officials to interest others in agriculture. The water shortage has been due to a lack of water in the streams at certain times of the year and to the difficulties of keeping diversion dams and ditches in operation on account of washouts caused by sudden floods in the rivers and by torrents in the tributary arroyos during heavy rains. In the river valleys many tracts of good land now lying idle could be made productive if sufficient water were obtainable. An extension of the present system to include these lands, however, would be likely to fail, from the same causes that contribute to the inadequacy of the present system.

Several officials of the United States Office of Indians Affairs, who are familiar with conditions in the reservation, have suggested the use of ground water for irrigation, and in response to these suggestions the Indian Office requested the United States Geological Survey to make an investigation of the ground-water conditions. The purpose of this investigation, as expressed in the letter of authorization, was "to determine the feasibility of drilling for an irrigation water supply, the examination to be restricted to land not included within the proposed San Carlos reservoir."

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... als of ... states ... ith c... he ... wat... n, ... an C... in ... his ... to ... ly ...

The field work covered a period of three months and was completed in December, 1914. Soon after its completion a report was made to the Indian Office containing (1) a brief description of the geologic conditions which influence the occurrence of ground water in this

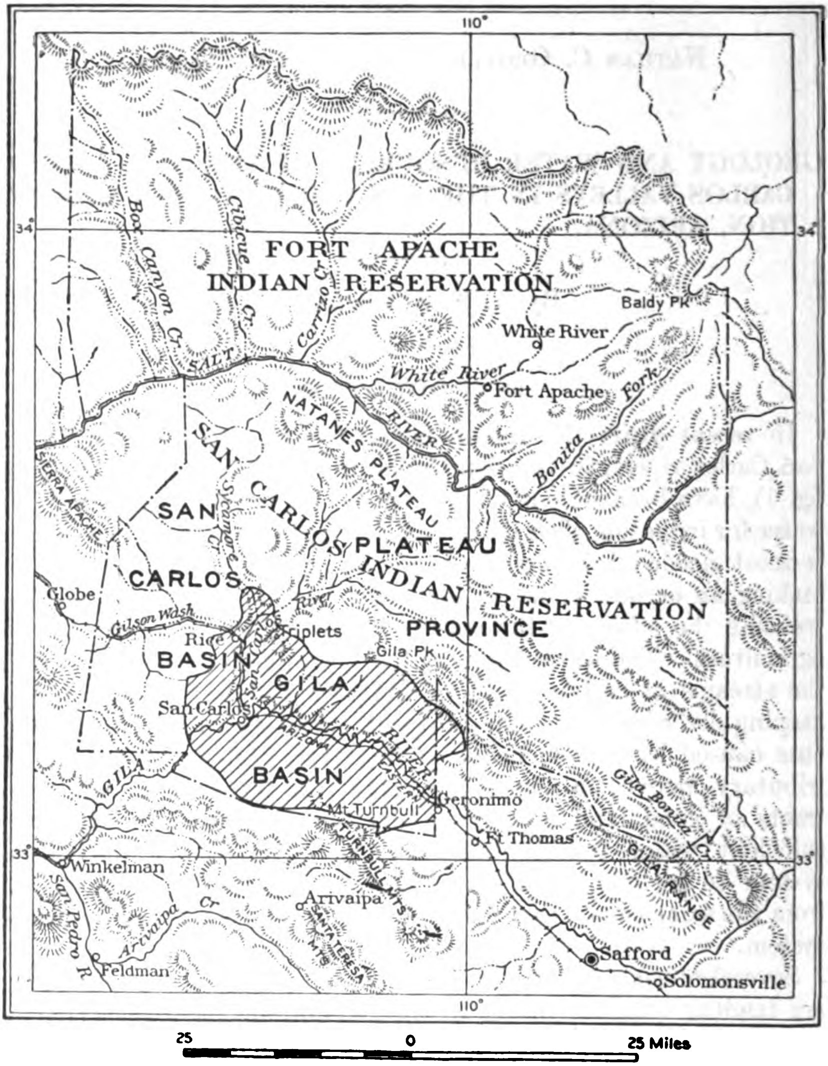
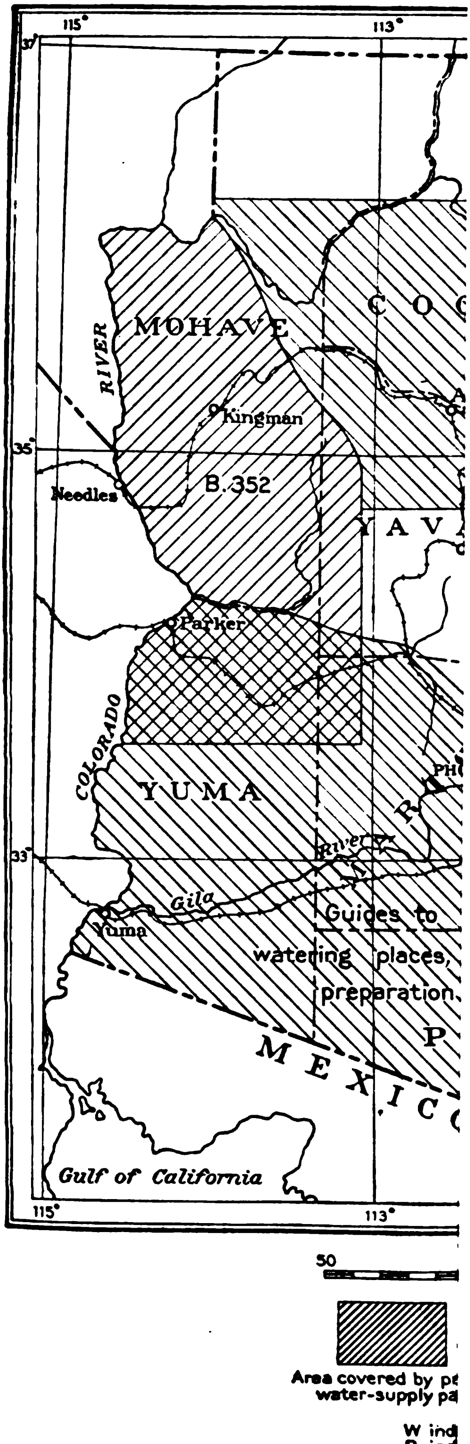


FIGURE 1.—Map of San Carlos Indian Reservation, Ariz., and adjacent regions, showing physiographic provinces.

region, (2) a discussion of the available pumping supplies in the Gila and San Carlos valleys, (3) a discussion of the artesian possibilities, and (4) a summary of conclusions, with certain definite recommendations as to the mode of procedure to develop a sufficient



MAP OF ARIZONA SHOWING AREAS COVE
SURVEY REL

ground-water supply and to increase the irrigated acreage in the reservation. The work was done under the direction of O. E. Meinzer, geologist in charge of the Survey's investigations relating to ground water.

To determine the available supplies for pumping from wells in the river valleys a study was made of the valley sediments with reference to their water-bearing capacity. To determine the quality of this supply for irrigation water samples were collected from representative wells and sent to the University of Arizona for analysis.

The artesian problem required the mapping of the geologic formations in the Gila and San Carlos basins and a study of their structure. The results are shown in Plate II and figure 2. Before recommending the development of either a pumped or artesian water supply it was

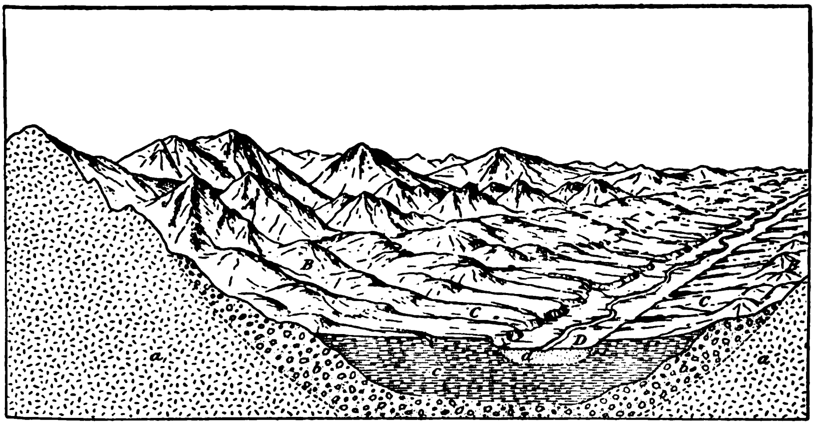


FIGURE 2.—Generalized view and cross section of Gila Basin, San Carlos Indian Reservation, Ariz., showing physiography and geology. *A*, Mountains; *B*, hilly belts, produced by erosion of older alluvial material (*b*); *C*, dissected ancient lake bottom; *D*, valley of Gila River, produced by erosion of lake beds (*c*) and later deposition of alluvium (*d*); *a*, pre-Quaternary igneous and sedimentary rocks; *b*, Gila conglomerate; *c*, lake beds; *d*, Recent alluvium.

important to know whether the amount of arable land in the San Carlos and Gila valleys above the proposed reservoir site was sufficient to warrant the drilling of deep wells or the construction of pumping plants. For this purpose a plane-table map on a scale of 2,000 feet to the inch was made of the portions of the San Carlos and Gila valleys above the proposed site (Pls. III and IV).

It was originally planned to include the results of this investigation in a more comprehensive paper on parts of southeastern Arizona. On account of the writer's resignation from the Geological Survey and the changes produced by the war the publication of such a paper has been indefinitely postponed, and it appears desirable to publish the present brief report, not only to make the local data more accessible but also because of the bearing of these data on the geologic history and ancient lakes or other bodies of standing water that have been observed in the fill of other parts of Gila Valley, in the fill of San Simon and San Pedro valleys, and, with less certainty, in the fill of Sulphur Spring and San Bernardino valleys.[1] These deposits in Gila, San Pedro, and San Simon valleys are no doubt related to one another and have an important bearing on the late geologic history and also on the water supply of the region.

Acknowledgments are due to the superintendent of the reservation, Mr. A. L. Lawshe, and to others for assistance in conducting the field work and for many courtesies; to Mr. C. H. Southworth, engineer of the Indian Office, for furnishing water analyses and for extending the hospitality of his camp; and to the University of Arizona and Mr. A. E. Vinson, of the university staff, who made analyses of the well waters that were collected.

PHYSIOGRAPHY AND DRAINAGE.

GENERAL FEATURES.

The San Carlos Indian Reservation can be divided into two parts—a plateau area, characterized by mountains and lava plateaus, and a basin area, characterized by broad intermontane basins or valleys underlain by river and lake deposits.

The plateau area covers most of the northern and eastern parts of the reservation, including the Ash Flat and Natanes plateaus. Its southern margin is formed by the Gila Range, and its western boundary by a line drawn approximately northward from the Triplets to the Salt River divide. (See fig. 1.)

The basin area includes the Gila Basin, an intermontane trough traversed by Gila River, which flows westward through the southern part of the reservation, and the San Carlos Basin, a similar trough traversed by San Carlos River, which flows southward through the western part of the reservation to San Carlos, where it discharges into the Gila. The basin area is bounded on the south by the Turnbull Range, on the west by the eastern ridges of the Mescal, Pinal, and Apache mountains, and on the north in part by the Gila Range. (See fig. 1.)

With the exception of a narrow strip of country south of Salt River, all of the reservation drains through a gorge which the Gila has cut in the Mescal Range and which is known as the box canyon. The southern part of the reservation, between the Gila and Turnbull ranges, drains directly into Gila River, which crosses the east boundary 2 miles west of Geronimo and flows west-northwestward for 25 miles to its junction with the San Carlos and thence southwestward for 10 miles to the southern boundary of the reservation.

[1] Blake, W. P., Lake Quiburis, an ancient Pliocene lake in Arizona: Arizona Univ. Monthly, vol. 4, February, 1902. Meinzer, O. E., and Kelton, F. C., Geology and water resources of Sulphur Spring Valley, Ariz.: U. S. Geol. Survey Water-Supply Paper 320, pp. 57–62, 1913. Schwennesen, A. T., Ground water in San Simon Valley, Ariz. and N. Mex.: U. S. Geol. Survey Water-Supply Paper 425, pp. 1–35, 1917.

A large territory extending from the vicinity of Globe eastward nearly to Gila Bonita Creek and northward as far as the Salt River divide drains into San Carlos River, which at San Carlos enters the Gila from the north.

GILA BASIN.

The surface of the Gila Basin can be divided into sharply contrasting belts that run parallel to its axis. (See fig. 2.)

On the north and south sides of the basin, adjacent to the mountains, are belts of hilly country which stand higher than the middle of the basin and which have evidently been produced by the erosion of what were at one time smooth alluvial slopes extending from the mountains toward the middle of the basin. Inside these hilly belts are belts of lower country which are the remnants of a lake bottom that once extended across the axis of the basin. This lake apparently came into existence after the alluvial slopes had been considerably eroded. As a result of the large amount of sediment deposited in the lake its bottom became smooth and had only gentle slopes toward the middle of the basin. Although this former lake bottom has been eroded since the disappearance of the lake, it still forms a strong contrast to the more anciently dissected marginal belts.

Inside the belts formed by the remnants of the ancient lake bottom is the valley of Gila River, which was cut by the river after the lake disappeared. The parts of the ancient lake bottom adjacent to the river valley have become much dissected, and with reference to the valley they form a rugged upland.

The river valley in its course within the reservation has an average width of 1 to 1½ miles. Farther up the river, between Solomonville and Fort Thomas, the valley is much wider, in some places reaching a width of 4 or 5 miles. The floor of the valley is formed of sediment deposited by the river in the trough channeled out of the lake beds.

The river valley may be divided into river channel, flood plain, and terraces. The valley contains a series of low terraces at successive levels, each bordered by a steep bank. (See section C–C′, Pl. II.) These terraces have been formed by the continued lateral cutting and shifting of the river, together with slight downward cutting. The lowest flats, which are only 2 to 4 feet above the stream channel, are flooded during high stages of the river and therefore may properly be called the flood plain.

SAN CARLOS BASIN.

The San Carlos Basin, though not so well defined as the Gila Basin and of more irregular outline, has the same general types of topography.

The valley of the San Carlos, like that of the Gila, has been channeled out of the older sediments that filled the rock basin and is boredge of the Turnbull Range, and along the east side of the Range. (See Pl. II.) It is carved into a great number of ro ridges that are separated from one another by deep gorges, fo a foothill belt that contrasts sharply with the rugged ranges and also with the intricately dissected but generally even surf the long, sweeping slopes that extend from the lower limit of the hills to the edges of the river valleys.

The conglomerate belt that skirts the Gila Range on the nort of the basin extends across the east boundary of the reserva Within the reservation it has an average width of about 3 mile stretches from the east boundary northward about 15 miles and appears beneath the lava flows centering about the Triplets.

The conglomerate belt adjacent to the Turnbull Range is 2 miles wide and extends westward from a locality 4 miles south of the box canyon to a point south of Bylas. Beyond this po was not traced, but it was seen to narrow considerably and to s southward along the eastern flanks of Mount Turnbull. At the margin it laps up against the range at an average altitude of a 4,200 feet. Its general surface slopes at the rate of about 450 to the mile, and its lower limit corresponds approximately to 3,300-foot contour.

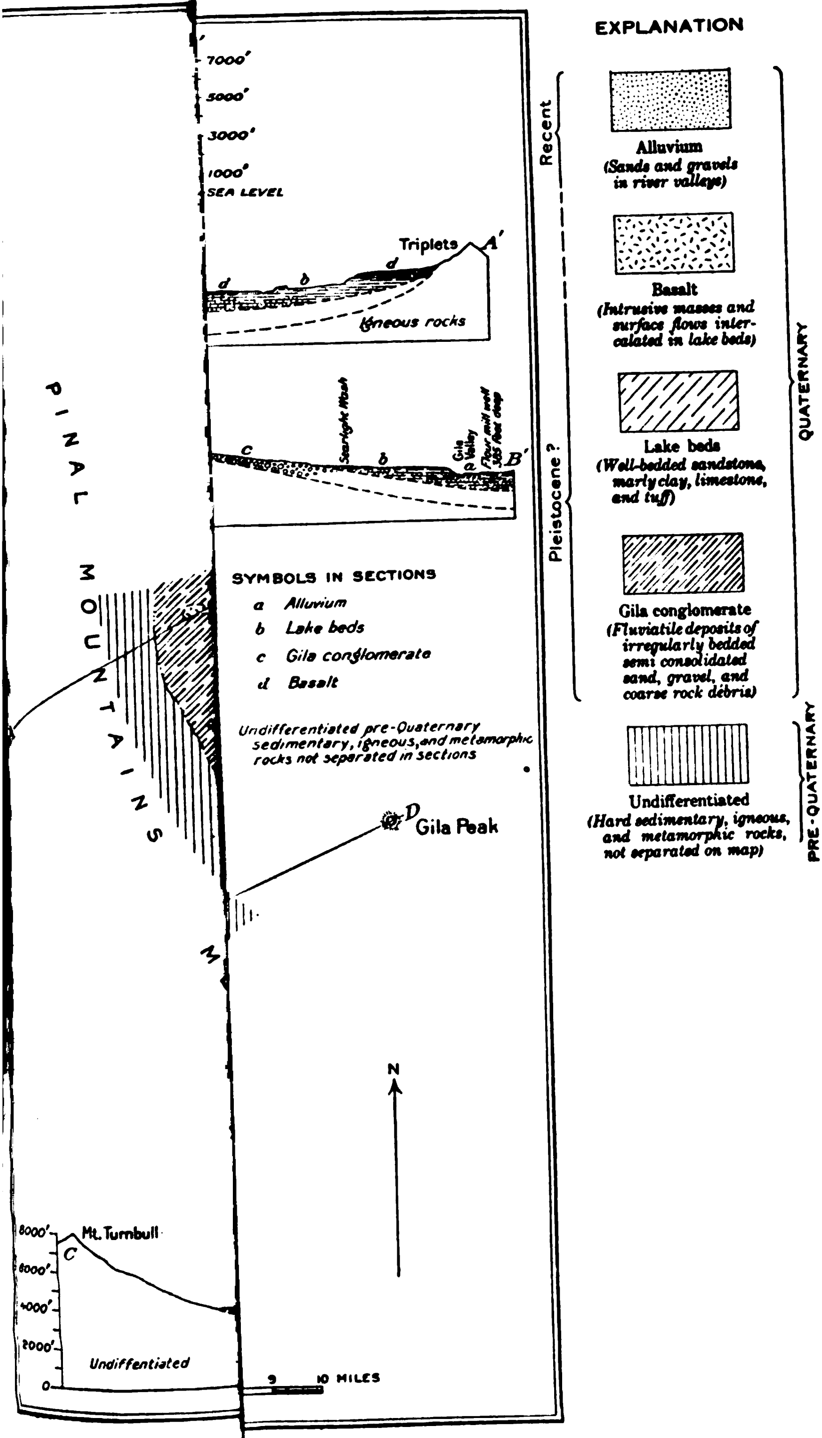
The conglomerate area on the west side of the San Carlos B extends northward from the box canyon along the flanks of eastern ridges of the Pinal Mountains. From the box canyon conglomerate is easily traced northward for 5 miles by its charac istic topography. Farther north the topographic distinction beco less marked, and the contact between the conglomerate and the o lapping sandstone is not easily traced.

As no complete sections were exposed the thickness of the form tion could not be determined, but on the basis of the position a slope of the rock floor as determined in some of the canyons, and the position and slope of the original upper surface of the formati as determined by the ridges of conglomerate, the maximum thickn of the Gila conglomerate in the middle of the Gila Basin is estimat to be not less than 1,000 feet. (See sections, Pl. II.)

LAKE BEDS.

Upon the eroded surface of the Gila conglomerate was deposited series of sandstones, tuffs, limestones, and marly clays which will b referred to collectively as the lake beds, for they were evidentl deposited in a body of standing water. This formation underlie the central and intermediate parts of the Gila and San Carlos basins, where it is at the surface except in the river valleys. (See Pl. II.)

The sandstone member of this formation is a soft, fine-grained, well-stratified buff sandstone, interbedded with thin layers or partings of a hard indurated sandstone of similar composition but usually


EXPLANATION
Recent
Alluvium
(Sands and gravels in river valleys)
Basalt
(Intrusive masses and surface flows intercalated in lake beds)
Lake beds
(Well-bedded sandstone, marly clay, limestone, and tuff)
Pleistocene ?
Gila conglomerate
(Fluviatile deposits of irregularly bedded semi consolidated sand, gravel, and coarse rock débris)
QUATERNARY
Undifferentiated
(Hard sedimentary, igneous, and metamorphic rocks, not separated on map)
PRE-QUATERNARY
7000′
5000′
3000′
1000′
SEA LEVEL
Triplets
A′
d
b
Igneous rocks
c
Searlight Wash
Gila Valley
a
Flour mill well 385 feet deep
B′
SYMBOLS IN SECTIONS
a Alluvium
b Lake beds
c Gila conglomerate
d Basalt
Undifferentiated pre-Quaternary sedimentary, igneous, and metamorphic rocks not separated in sections
PINAL MOUNTAINS
D
Gila Peak
N
8000′
6000′
4000′
2000′
0
Mt. Turnbull
C
Undiffentiated
10 MILES

maps.

Carlos Basin. Faulting has probably occurred in connection
disturbances that accompanied the outpouring of the lava
places.

ALLUVIUM.

The youngest sedimentary deposit in the area is the allu
the Gila and San Carlos valleys. It consists of sand and gra
down in troughs channeled out of the lake beds. Most of
material has been deposited by the rivers and resembles the
that forms the bottoms of the present channels. The grave
the most part been brought down through the arroyos open
the valleys from the sides.

QUATERNARY HISTORY.

The Quaternary history of the region can be outlined as fol

1. Aggradation in the rock troughs, resulting in the depos about 1,000 feet of gravelly alluvium and the construction o steep alluvial slopes.
2. Erosion of the alluvial slopes.
3. Submergence of the lower parts of the alluvial slopes by Deposition of sand, tuff, and other sediments in the lake to a ma depth of probably 800 feet. Continued erosion of the parts slopes that were not submerged.

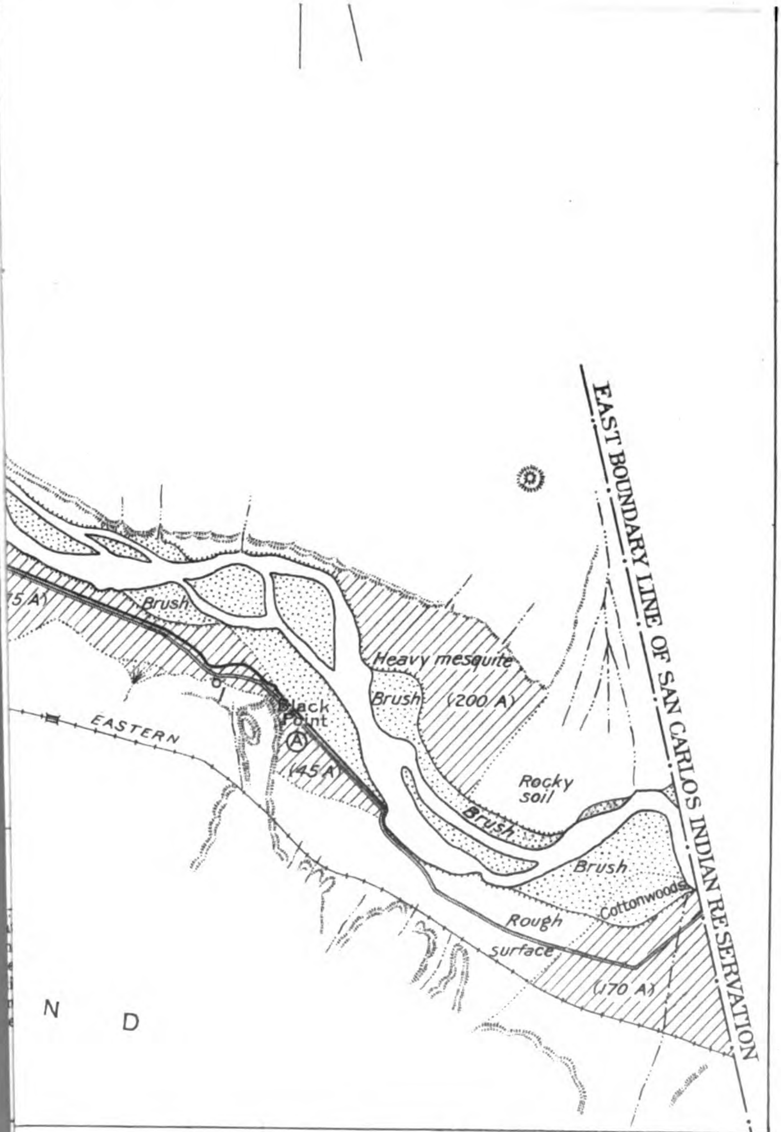
Volcanism, resulting in the outpouring of basalt, the deposit tuff, and minor faulting and folding, at least chiefly, in the lat of the period covered by epochs Nos. 1, 2, and 3, but may no been confined to No. 3.

4. Disappearance of the lake. The cause of the formation o lake and that of its disappearance are not known. Excavati the valleys by Gila and San Carlos rivers in the old lake bottom intricate dissection of the lake bottom near the river valleys.
5. Partial refilling of the river valleys through deposition b streams, followed by slight changes in stream grade that result the formation of a series of low terraces. Continued erosion o lake bottom.

Erosion of the older alluvial slopes was practically continuous epoch No. 1; the erosion of the mountain ranges continued thro out the period, and the erosion of the lava beds began immedi after their extrusion and continued without interruption.

CLASSIFICATION OF LANDS.

The lands of the Gila and San Carlos valleys may be classe arable or nonarable on the basis of their suitability for farming irrigation if a water supply is provided. Their suitability for purpose depends in part on their topography and the quality of t soil.



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XPLANATION

NONARABLE LAND

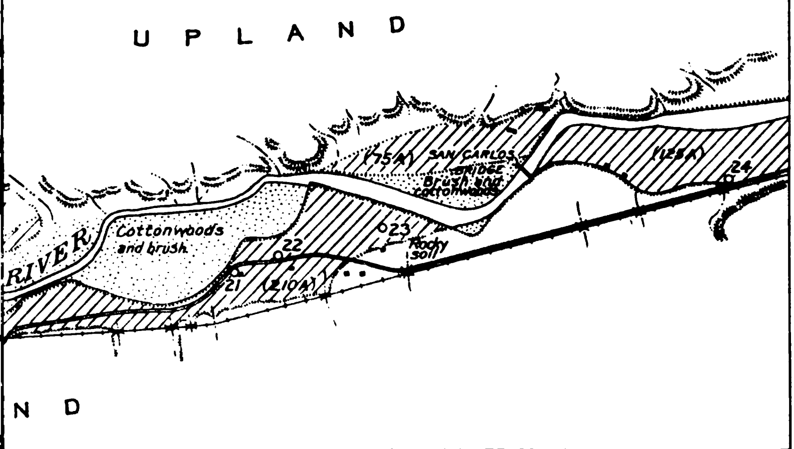
de the
r con-
gation
indi-
1,840

Terraces and uplands with dissected surface and rocky soil. Land not suitable for farming

Wells. Numbers correspond to numbers used to designate wells in the text

Scale $\frac{1}{48,000}$

0 1 MILE



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SERVOIR SITE
ion

San Carlos River is ordinarily dry for a considerable part of each year, but if the total run-off during normal years could be economically stored it would probably be sufficient to irrigate several thousand acres of land. It is doubtful, however, if feasible storage sites exist on this stream.

The following tables give the essential results of measurements of stream flow on Gila River in the vicinity of San Carlos and on San Carlos River that have been made by the United States Geological Survey. The records of flow on Gila River at San Carlos from 1899 to 1905 are of exceptional value and interest, in that they cover a period of the most severe drought that has been experienced in the history of modern agricultural development in Arizona.

GILA RIVER AT SAN CARLOS, ARIZ.

LOCATION.—Half a mile south of San Carlos Indian Agency at San Carlos, Gila County, half a mile below San Carlos River, and about 7 miles above dam site in box canyon.

RECORDS AVAILABLE.—July 11, 1899, to November 27, 1905 (incomplete). From August 17, 1910, to February 5, 1911, a station was maintained just below the Arizona Eastern Railroad bridge and half a mile above San Carlos River. Because of insufficient data discharges have not been computed for this station. For discharge measurements and gage heights see Water-Supply Papers 289 and 309.

GAGE.—Inclined staff on right bank.

DISCHARGE MEASUREMENTS.—Made from cable a short distance above gage.

CHANNEL AND CONTROL.—Sandy and badly shifting.

EXTREMES OF DISCHARGE.—Discharge varies from zero flow to enormous floods, probably exceeding 100,000 second-feet. No accurate measurements of extreme floods have been made.

DIVERSIONS.—Water for irrigating several thousand acres was diverted above the station for use in the Solomonville and Duncan valleys. A small amount of water (probably not exceeding 5 second-feet at any time) was also diverted just above the gage for irrigating lands within the reservation.

ACCURACY.—Results liable to considerable error, particularly during low stages, on account of shifting channel and control.

Monthly discharge of Gila River at San Carlos, Ariz., for 1899–1905.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1899.				
July 11-31	11,000	195	1,760	73,300
August	2,740	90	408	25,100
September	6,860	75	416	24,800
October 1-18	300	75	143	5,110
The period				128,000
1900.				
April 4-30	75	3.5	5.7	305
May	4.5	.9	2.4	148
June	.8	.3	.6	36
July	.5	.1	.3	18
August	2,750	1.0	198	12,200
September	6,900	25	937	55,800
October	102	36	60.0	3,690
November	2,900	10	177	10,500
December	118	66	102	6,270
The period				89,000
1901.				
January	1,150	36	141	8,670
February	2,110	420	1,110	61,600
March	1,080	155	426	26,200
April	155	6	59.3	3,530
May	8	4	5.5	338
June	6	.3	2.6	155
July	3,600	0	377	23,200
August	1,870	67	482	29,600
September	1,700	18	212	12,600
October	460	10	67.5	4,150
November	630	133	223	13,300
December	155	94	110	6,760
The year	3,600	0	262	190,000
1902.				
January	94	50	79.1	4,860
February	57	26	45.9	2,550
March	26	8	13.5	830
April	2	0	.1	4
May	0	0	.0	0
June	0	0	.0	0
July	400	0	28.2	1,730
August	1,820	0	407	25,000
September	340	40	114	6,780
October	4	0	.1	8
November	30	0	1.2	71
December	2,750	0	583	35,800
The year	2,750	0	107	77,600
1903.				
January	360	79	169	10,400
February	73	43	53.3	2,960
March	110	10	35.7	2,200
April	147	9	50.6	3,010
May	8	.6	2.2	135
June	670	.4	107	6,370
July	575	.2	53.3	3,280
August	3,570	1	963	59,200
September	2,150	16	223	13,300
October	405	38	106	6,520
November	78	42	55.4	3,300
December	43	22	35.5	2,180
The year	3,750	.2	156	113,000

Monthly discharge of Gila River at San Carlos, Ariz., for 1899–1905—Continued.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1904.				
January	36	27	31.7	1,950
February	48	17	32.6	1,880
March	15	9	11.0	676
April	12	2	5.3	315
May	115	0	8.7	535
June	0	0	0	0
July	1,580	0	143	8,790
August	3,200	240	952	58,500
September	1,300	20	232	13,800
October	5,870	20	825	50,700
November	210	42	112	6,660
December	660	31	306	18,800
The year	5,870	0	224	163,000
1905.				
January 1-11	7,000	120	1,290	28,100
May 14-31	1,400	440	949	33,900
June	675	30	255	15,200
July	740	5	99.6	6,120
August	1,090	110	441	27,100
September	1,650	68	544	32,400
October	705	28	149	9,160
November 1-27	6,150	58	1,100	58,900

NOTE.—No record for the periods Oct. 19, 1899, to Apr. 3, 1900, and Jan. 12 to May 13, 1905.

GILA RIVER NEAR SAN CARLOS, ARIZ.

LOCATION.—One mile above dam site in box canyon, in San Carlos Indian Reservation, about 6 miles below San Carlos Indian Agency, Gila County.

RECORDS AVAILABLE.—April 29, 1914, to September 30, 1917.

GAGE.—Stevens water-stage recorder on left bank about 1 mile above dam site.

DISCHARGE MEASUREMENTS.—Made by wading near gage or from cable about 1 mile above gage.

CHANNEL AND CONTROL.—Channel composed of sand, gravel, and boulders. A semi-permanent control is formed by rapids over heavy boulders just below gage. Control shifts somewhat because of sand filling in and washing out from crevices between the boulders.

EXTREMES OF DISCHARGE.—1914–1917: Maximum stage 25.5 feet January 20, 1916 (approximate discharge, determined from extension of rating curve, 92,000 second-feet); minimum stage 0.15 foot, July 1, 1914 (discharge, 1 second-foot).

DIVERSIONS.—Water for irrigating about 30,000 acres is diverted from river in valley just above station. At times this diversion reduces the low flow practically to zero at the station. About 7,000 acres is irrigated from this stream above the station at Guthrie.

ACCURACY.—Results fair except for extremely high or low stages or for estimated periods. (See footnote to monthly discharge table.)

Monthly discharge of Gila River near San Carlos, Ariz., for years ending Sept. 30, 1914–1917.

Month.	Discharge in second-feet.			Run-off (in acre-feet).
	Maximum.	Minimum.	Mean.	
May			8	492
June	405	3	725	4,310
July	2,380	1	968	59,500
August	3,220	291	1,080	66,400
September	2,430	120	612	36,400
The period				167,000
1915.				
October	6,150	116	1,170	71,900
November	3,220	250	781	46,500
December		490	6,180	380,000
January			2,420	149,000
February			3,950	219,000
March			3,570	220,000
April			3,870	230,000
May			1,130	69,500
June			193	11,500
July			907	55,800
August			500	30,700
September			267	15,900
The year			2,100	1,500,000
1916.				
October	164	26	66.7	4,100
November	134	26	71.5	4,250
December	387	130	222	13,600
January		387	12,800	787,000
February			3,290	189,000
March			2,890	178,000
April	2,410	533	1,080	64,300
May	968	127	403	24,800
June	121	17	57.3	3,410
July	190	12	87.6	5,390
August	1,770	144	788	48,500
September	2,670	128	720	42,800
The year		12	1,890	1,370,000
1917.				
October	33,500	103	3,240	199,000
November	822	330	442	26,300
December	444	316	347	21,300
January	14,400	328	1,850	114,000
February	1,550	514	964	53,500
March	1,910	418	774	47,600
April	938	190	482	28,700
May		72	152	9,350
June	66	15	34.8	2,070
July	1,050	14	187	11,500
August	827	57	221	13,600
September			48.2	2,870
The year	33,500	14	732	530,000

NOTE.—Mean discharge for May and December, 1914; January to September, and December, 1915; January to March, and December, 1916; and May and September, 1917 estimated or partly estimated by comparison with records at other stations on this stream.

SAN CARLOS RIVER AT SAN CARLOS, ARIZ.

LOCATION.—Opposite railroad station at San Carlos, Graham County, in San Carlos Indian Reservation, about half a mile above junction with Gila River.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—August 17, 1910, to January 12, 1911,[1] and April 1, 1914, to September 30, 1915, when station was discontinued.

[1] Discharge not computed from Aug. 17, 1910, to Jan. 12, 1911. For discharge measurements and gage heights see Water-Supply Papers 289 and 309.

Gage.—Stevens water-stage recorder on left bank. The original gage, which was used from August 17, 1910, to January 12, 1911, was a vertical staff fastened to right pier of railroad bridge, downstream end.

Discharge measurements.—Made by wading or from cable at gage.

Channel and control.—Sand, badly shifting at all stages. Section flat and nonsensitive.

Extremes of discharge.—Stream dry a part of each year. July 26, 1915, a heavy flood occurred, covering the surrounding lowlands. Discharge not determined.

Diversions.—No record of any diversions, although a small amount was probably diverted above the gage for irrigation.

Accuracy.—Results poor because of shifting control and insufficient discharge measurements.

Monthly discharge of San Carlos River at San Carlos, Ariz., from Apr. 1, 1914, to Sept. 30, 1915.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1914.				
April	0	0	0	0
May	0	0	0	0
June	21	0	2.1	125
July	165	0	12.8	762
August	145	0	47	2,800
September	90	10	32.3	1,920
October	375	10	59	3,630
November	290	25	60	3,570
December 1-18	150	40	63	2,250
The period	375	0	292	15,100
1915.				
January 1-28	145	40	79	4,390
February 1-19	210	5	128	4,830
March	160	7	97	5,960
April	190	6	46	2,740
May	132	2	36	2,210
June	155	0	2.6	155
July 1-25	0	0	0	0
August			[a] 15	920
September			[a] 5	300

[a] Estimated.

Note.—Floods above the limit covered by the rating curve occurred during the period Dec. 19-30, 1914, Jan. 29-31, Feb. 20-22, and July 26-31, 1915. Discharge Dec. 31, 1914, 150 second-feet. Mean discharge Feb. 23-28, 1915, 15.7 second-feet.

PRESENT IRRIGATION.

All irrigation on the reservation in 1914 was done with water from the Gila and San Carlos rivers, diverted into the main canals by brush and earth dams thrown across the channels. These dams are temporary affairs that wash out at each flood and must be rebuilt at the beginning of each irrigating season and perhaps several times during the season. They are necessarily low and are too frail to impound the water and raise it much above its natural level, so that the intake of the ditch can be little higher than the bottom of the channel. This condition allows little opportunity for the silt to settle before the water is taken into the canals. Consequently the canals, especially those on the Gila, become choked with silt and must frequently be dug out. Flood waters discharging into the canals through gullies from the sides of the valley also deposit much silt and often destroy sections of the canals by cutting across them.

Permanent dams that could withstand the floods would save much expense and also relieve the present water shortage to some extent, for much water is now lost by seepage through the temporary dams, even when the rivers are low. On account of the unstable character of the bottom and sides of the channels, however, permanent dams may not be practicable on Gila River. On the upper San Carlos a suitable site for a permanent dam could probably be found, but whether the additional land that could be irrigated with the water saved by a permanent dam would warrant its construction is not certain.

The enlargement of the present irrigation system on Gila River to include more of the arable lands in the valley would require the construction of canals at higher levels than those now in use. If permanent dams are not practicable the construction of high-level canals would necessitate either carrying the ditch head much farther up the river and outside of the reservation, or else pumping from the river into the high-level canals.

The most serious drawback to the present irrigation system is the inadequacy of the water supply during certain months of the year. Gila and San Carlos rivers are usually lowest in May, June, and July, the months during which water is most needed. It is not unusual for these streams to dry up entirely at times during these months, so that it becomes necessary to scrape out holes in the sand and gravel of the channels to provide water for stock. According to the stream-gaging records of the United States Geological Survey for 1914 no water passed the gaging station on San Carlos River at San Carlos during April and May, but in June 125 acre-feet and in July 762 acre-feet passed the station. At the gaging station above the box canyon on the Gila the average flow for the first 22 days after the automatic gage was in operation, from May 27 to June 17, was 18 acre-feet per day. As these records were obtained below the irrigated districts of the reservation they do not show the amount of water taken out by ditches.

The yearly cost of keeping up the ditches and diversion dams on the reservation is from $1,800 to $2,000. In 1913 the expenditure in preparation for the season's irrigation was $1,908, according to the statement of the superintendent, A. L. Lawshe. The total area irrigated, according to Mr. Lawshe, was 1,428 acres, of which 421 acres was in the Bylas district, 469 acres in the San Carlos district, and 538 acres in the Peridot district. The cost per acre was therefore $1.34.

SHALLOW GROUND WATER.

OCCURRENCE AND QUANTITY.

Water is found at shallow depths in the Recent alluvial fill of the Gila and San Carlos valleys. Most of the wells are on the low terraces above the stream channels. Most wells dug by the Indians for domestic water supplies are not more than 15 or 20 feet deep, but several constructed by white settlers on higher ground are deeper. The Rice school well, at the base of the bluffs on the north side of San Carlos Valley (No. 3, Pl. IV), is 36 feet deep and has a depth to water of 32 feet. Two large dug wells at the flour mill at San Carlos are 30 and 32 feet deep. The well at the railroad station at Calva, near the foot of the bluffs on the south side of Gila Valley (No. 13, Pl. III), is 75 feet deep, and the water table here is 45 feet below the surface.

The shallow wells on the level arable terraces end in sand and fine gravel similar to the material in the present stream channels. The general correspondence of the water level in the wells with the level of the water in the streams indicates that the alluvium is saturated about to the stream level.

The water is supplied by percolation from the rivers, by water discharged into the valleys through tributary arroyos, and by direct rainfall on the valleys. The principal contributions are probably made by percolation of stream water into the bottoms and sides of the river channels. Second in importance are contributions made by tributary arroyos, a part of whose water sinks into the gravel near the edges of the valleys. The amount of water contributed by direct rainfall is relatively small. The rapidity with which water withdrawn from wells is replenished depends on the porosity and continuity of the water-bearing beds and the location of the wells with respect to the streams. Wells close to the stream channels will probably yield more freely than wells farther back, at a greater distance from the principal source of supply. Where large quantities of water are required it is therefore generally not advisable to sink wells at very great distances from the streams.

The lake beds, which underlie the Recent alluvium, yield some water but do not constitute good water-bearing material. The large dug wells at the San Carlos flour mill, on the gently sloping ground above the San Carlos bottoms, penetrate about 15 feet of coarse sand and gravel and then pass into the lake beds. The upper sands and gravels are above the water level and are therefore dry, and the water is said to come out of thin "clay" seams in soft fine-grained sandstone. The wells are about 30 feet deep and have an aggregate cross-sectional area of about 1,400 square feet. In summer about 50,000 gallons of water is pumped from them during a 10-hour day.

At this rate these large wells are soon pumped down, and in order to continue pumping it is necessary to put into operation a syphon connecting the large wells with a well on the terrace of San Carlos River. When pumping is continuous this well, which is only 10 feet deep and 8 by 8 feet in cross section and which ends in Recent alluvium, furnishes most of the water.

A number of years ago two wells were drilled from the bottom of the larger of the two wells at the flour mill in the hope of getting an increased supply from a deeper stratum. One of these wells reached a depth of about 115 feet, and the other was sunk to a depth of 385 feet below the surface. Both wells were failures, although in the 385-foot well a small supply of water was obtained at 85 feet. All the way down these wells were in the same fine-grained sandstone—probably belonging to the lake beds—found in the lower parts of the dug wells.

QUALITY.

The mineral character of waters from wells and from Gila River is shown in Tables 1 and 2. The samples whose analyses are given in Table 1 were collected by the writer in the course of the field investigation. Table 2 gives the results of analyses of waters from a number of shallow test wells put down in the Gila Valley several years ago under the direction of James W. Martin, superintendent of irrigation for the Indian Office.

In samples 1, 9, 12, 13, and 14 (Table 1), which represent waters from shallow wells in the Gila Valley above the proposed San Carlos reservoir site, the amount of total solids ranges from 1,330 to 2,412 parts per million. Samples 9, 12, 13, and 14 are very high in their content of chlorine, one of the constituents of sodium chloride or common salt, ordinarily referred to as one of the "white alkalies." These waters are practically worthless for irrigation under ordinary conditions. Sample 1 contains less sodium chloride but contains a prohibitive amount of sodium carbonate or "black alkali," which is even more harmful than white alkali. The sample of water from Gila River at the canal intake is representative of the water now used for irrigation on the reservation. Comparison with the well waters shows that it contains less than half as much white alkali. The fact that it has been used successfully for many years for the irrigation of crops in the Gila Valley is sufficient proof of its value as an irrigating water. The effects of its continued use, however, are shown by the alkali spots that appear in the alfalfa fields, and it is questionable whether the crops could endure a much greater amount of these salts. A doubling of the amount of alkali, which would result from the use of well waters such as the analyses represent, would probably prove fatal to most crops, even under the most favorable conditions of soil and drainage.

The sample from the pumping plant at San Carlos (Table 1) is a mixed water from wells at the flour mill and a well about 500 feet northeast of the flour mill, on the San Carlos River bottoms. This water contains less soluble salts than any of the other well waters that were analyzed. It contains a moderate amount of white alkali and a small amount of the more injurious black alkali. As an irrigating water it may be classed as fair, and in its probable effects on crops it is comparable to the water from Gila River.

Unfortunately no analyses of well waters from the San Carlos Valley are available. A sample thought to be fairly representative of well waters in the San Carlos Valley was obtained from a driven well near the river at the new steel bridge across the San Carlos. The sample was too small for a complete analysis, however, and therefore no report on this water was obtained.

TABLE 1.—*Chemical composition of water from wells and from Gila River in San Carlos Indian Reservation, Ariz.*

[Samples collected by A. T. Schwennesen; analyzed by A. E. Vinson at the laboratories of the Arizona Agricultural Experiment Station.]

No. of well.[a]	Designation and location.	Kind of well.	Depth of well.	Depth to water level.	Composition (parts per million). Total solids.	Carbonate radicle (CO_3).	Bicarbonate radicle (HCO_3).	Sulphate radicle (SO_4).	Chloride radicle (Cl).	Permanent hardness stated as $CaSO_4$.	Black alkali stated as Na_2CO_3.	Alkali coefficient.[b]	Classification for irrigation.[b]
			Feet.	*Feet.*									
1	Domingo's well, one-fourth mile west of Black Point.	Dug	16.3	13.5	1,330	12	480	152	354		263	2.8	Poor.
9	Indian well, 400 feet southeast of new Bylas well at Bylas.	do	17	16	1,852		403	236	660	337		3.1	Do.
12	Domestic well on agency farm at Bylas (old well).	do	15.6	14.2	2,376		385	303	876	544		2.4	Do.
13	Railroad well at Calva siding.	Dug and drilled.	45	75	2,412		536	306	880	190		2.2	Do.
14	Well at Cowboy Camp, 1 mile west of Naches siding on Gila River.	Dug			1,864		415	257	658	239		3.0	Do.
	Wells at agency pumping plant at San Carlos.	do	[c] 30, [c] 32, [d] 10		816		409	68	204		93	6.0	Fair.
	Gila River at intake of canal, three-fourths mile southeast of Black Point.				1,008		291	152	307	141		6.5	Do.

[a] Numbers refer to numbers used to designate wells on map (Pl. III).

[b] Calculated according to Stabler's formulas (Stabler, Herman, Some stream waters of the western United States: U. S. Geol. Survey Water-Supply Paper 274, pp. 177-179. 1911), modified as follows: If black alkali is reported, use Stabler's formula 13*c* and compute sodium as follows: $Na=0.4339\ Na_2CO_3+0.6486\ Cl+0.4789\ SO_4$. If permanent hardness is reported and SO_4 equals or is less than $0.7056\ CaSO_4$, use Stabler's formula 13*a*. If permanent hardness is reported and SO_4 is more than $0.7056\ CaSO_4$, use Stabler's formula 13*b*. If formula 13*a* or 13*b* is required, compute sodium as follows: $Na=0.6486\ Cl+0.4789\ (SO_4-0.7056\ CaSO_4)$.

[c] At flour mill.

[d] About 500 feet east of flour mill on San Carlos River bottoms.

TABLE 2.—*Chemical composition of water from test wells in Gila Valley in the San Carlos Indian Reservation.*

[Analyses made at laboratories of Arizona Agricultural Experiment Station under direction of R. H. Forbes. Results of analyses taken from report of J. W. Martin, superintendent of irrigation, United States Indian Office, furnished by C. H. Southworth, engineer, United States Indian Office.]

Designation.[a]	Source.	Quantitative analysis (parts per million).			Qualitative analysis.				Classification for irrigation.[b]
		Total solids at 110° C.	Chlorides in terms of NaCl.	Alkalinity in terms of Na_2CO_3.	Sulphate.	Magnesia.	Lime.	Bicarbonates.	
A	Dug test well southeast of Black Point.	884	343	97	Moderate	Very slight	Moderate	Moderate	Objectionable on account of black alkali.
B	Dug test well on north side of river opposite Navajo Bill Point.	11,774	10,180	762	Very strong	Strong	Very strong	Very strong	Objectionable on account of extreme amounts of total soluble solids.
C	Dug test well 1,500 feet south of river bank, 1½ miles east of Dewey Flat.	1,584	970	359	Moderate	Moderate	Strong	Strong	Not desirable on account of large amount of total soluble solids.
D	Dug test well on north side of Gila River 1¼ miles northwest of Cowboy Camp.	2,380	1,590	212	Strong	do	do	do	Not desirable on account of high sodium chloride content.

[a] Approximate location shown on map (Pl. III).

[b] Comments by R. H. Forbes in report to J. W. Martin.

USE FOR IRRIGATION.

Although no definite tests have been made there is reason to believe that the recent alluvium would yield enough water, if pumped from shallow wells, to irrigate all the arable lands. As the principal contributions to the ground-water supply are received from seepage of the streams into the bottoms and sides of the stream channels, wells should be located as near the channels as possible if large yields are desired. Wells and pumping plants should, however, be placed where there is no danger that they will be washed out, for the streams are continually changing their courses and wearing away the lands adjacent to their channels.

Irrigation with water pumped from wells would have an important advantage over irrigation with surface water in that the supply would be nearly uniform throughout the year, whereas surface supplies are most abundant when irrigation is not needed and least abundant in the dry season. Its cost would be considerably higher than the present cost of irrigating with surface water, but this higher cost would be compensated to a large extent by an increased crop yield made possible by an assured water supply in the dry season, during which the crops often suffer.

The principal objection to the use of water from wells is the poor quality of the water. The waters of the Gila Valley are so heavily impregnated with mineral matter as to require extraordinary precautions to prevent the accumulation of an injurious amount of alkali in the soil, and it is doubtful whether they could be successfully used for any length of time even under the most favorable conditions of soil and drainage. The data as to the quality of the ground waters of the San Carlos Valley are meager, but there is reason to believe that these waters are better than those of the Gila Valley.

Final judgment as to the availability of the shallow ground waters may well be deferred until practical tests have been made and their effects on crops noted under actual working conditions. Experiments of this kind should be carried on at the Bylas farm, in the Gila Valley, where a small pumping plant has lately been installed, and similar experiments should be made in the San Carlos Valley.

To the extent that the shallow ground water is found to be good enough for irrigation, it can be used advantageously on the tracts now under cultivation to supplement the inadequate surface water supply, and also on the arable tracts that lie above the present ditch system.

ARTESIAN WATER.

The principles upon which artesian flows from sedimentary rocks depend are explained in textbooks on geology and in many of the publications of the United States Geological Survey. The necessary conditions are concisely stated by T. C. Chamberlin[1] as follows: (1) A pervious stratum to permit the entrance and the passage of the water; (2) a water-tight bed below to prevent the downward escape of the water; (3) a like impervious bed above to prevent escape upward, for the water, being under pressure from the fountain head, would otherwise find relief in that direction; (4) an inclination of these beds so that the edge at which the waters enter will be higher than the surface at the well; (5) a suitable exposure of the edge of the pervious stratum, so that it may take in a sufficient supply of water; (6) rainfall adequate to furnish this supply; (7) absence of any means of escape for the water at a lower level than the surface at the well.

In the Gila Basin and in the lower part of the San Carlos Basin the essential conditions for an artesian flow as stated above are believed to be fulfilled, the Gila conglomerate serving as the pervious stratum for the entrance and passage of the water, the rock floor upon which it rests serving as the lower impervious stratum, and the lake beds serving as the upper impervious stratum. (See section D-D', Pl. II.)

Wherever the Gila conglomerate is exposed it has the appearance of a good water-bearing material. Its outcrops along the flanks of the ranges, several hundred feet above the river valleys, provide a large intake area for the absorption of direct rainfall and run-off from the mountains above. If the conglomerate extends to the axes of the basins and is of the same character as at the outcrops, it fulfills the first requisite given above. Its character near the axes of the basins, where it is hidden beneath the overlying formations, can only be conjectured. It probably contains less coarse material there than where it crops out, but there is no reason to believe that it is entirely devoid of water-bearing gravels.

The rock basins in which the Gila conglomerate lies appear to be sufficiently tight to prevent the escape of ground water. At their lower ends the Gila and San Carlos basins are closed by mountains that allow the escape of surface water through a narrow gorge (the box canyon), but are believed to hold back effectively the deep ground waters. The rock floor of the basins is likewise believed to be sufficiently impervious to prevent the escape of ground water downward and out of the basins.

The lake beds occupy the middle parts of the basins and extend far up on the sides, blanketing the Gila conglomerate to elevations several hundred feet above the river valleys. On the whole they seem to be an effective artesian cover, comparatively free from fractures and sufficiently impervious in themselves to prevent, at

[1] U. S. Geol. Survey Fifth Ann. Rept., pp. 134-135, 1885.

least in part, the upward escape of water imprisoned beneath them. Along the north side of the Gila Valley, opposite Navajo Bill Point and at several other places farther east, small springs issue near the base of the bluffs. A group of springs occurs in the large arroyo which enters the Gila from the north opposite Bylas siding. There is another spring in Kelly Wash, on the south side of the basin, 2 miles southeast of San Carlos. (See Pl. II.) If these springs represent leakage from the artesian reservoir, as seems probable, the lake beds are not perfectly water-tight, but apparently the amount of water lost in this way is not great. At a number of places there are also evidences of a possible disturbance of the artesian cover, as indicated by lava intrusions and slight folding and faulting.

In the Gila Basin favorable artesian conditions exist along the north side of the basin for 15 miles from the east boundary of the reservation to a point 8 miles east of the Triplets. Farther west the Gila conglomerate is not exposed and consequently the artesian prospects are not so good. On the south side of the Gila Basin favorable artesian conditions are found for a distance of 20 miles below Bylas and a point 4 miles east of the box canyon.

In the San Carlos Basin artesian structure exists along the west side for 5 miles northward from the box canyon. Beyond that point the structure may be less favorable on account of possible serious disarrangements of the strata as a result of volcanic disturbances, which are indicated by numerous lava flows. On the east side the absence of outcrops of the Gila conglomerate makes conditions unfavorable.

As the structure is favorable to artesian conditions on one or both sides of the Gila Basin between the east boundary of the reservation and San Carlos, there are prospects that artesian water can be obtained in the river valley between these points by drilling through the recent alluvium and lake beds into the Gila conglomerate.

As the structure is favorable to artesian conditions on the west side of the San Carlos Basin for 5 miles north from the box canyon, there are also prospects that artesian water can be obtained in the river valley from San Carlos north to the new San Carlos steel bridge. All this part of the valley, however, is inside the proposed reservoir site. In the part of the San Carlos Valley above the steel bridge conditions do not appear to be favorable for obtaining an artesian supply.

According to the writer's estimates, based entirely on the probable relative positions of the formations as represented graphically in the cross sections in Plate II, the average thickness of the lake beds near the middle parts of the basins does not exceed 700 feet. However, as no complete sections are exposed, this estimate may be much too low. As the lake beds were laid down on an eroded and somewhat hilly surface, their thickness probably varies from place to place. In some places it may be necessary to drill 1,000 or even 1,500 feet to reach the Gila conglomerate, and as much as 2,000 feet to penetrate the conglomerate deep enough to make a conclusive test.

It is impossible from data obtained in a geologic investigation to predict definitely the presence or absence of artesian water, for the reason that unfavorable conditions may exist underground which do not appear at the surface. However, the investigation that has been made shows that the conditions, in so far as they can be observed, are sufficiently favorable to warrant the drilling of a test well.

As no wells have been drilled into the Gila conglomerate, the quality of the water which it contains is not known. The source of the water is the rain on the outcrop and the run-off from the hard igneous and sedimentary rocks of the mountains above. The water as it enters the Gila conglomerate is therefore probably only moderately mineralized. In passing downward to lower levels through the conglomerate it dissolves more or less mineral matter, but, to judge from the character of the materials in this formation as revealed in its outcrops, the amount of soluble matter is not large. There may, however, be buried saline beds along the axes of the valleys. In view of the source of the water contained in the Gila conglomerate and the character of the formation, there is reason to believe that the water is good enough for use.

SUMMARY AND CONCLUSIONS.

1. The part of the Gila Valley within the reservation and outside of the proposed reservoir site contains about 4,595 acres of arable land. In 1913 only 421 acres, or less than 10 per cent of this arable land, was irrigated and farmed.

2. The San Carlos Valley, all of which lies within the reservation, contains 1,840 acres of arable land above the proposed reservoir site. In 1913, 538 acres, or a little more than 30 per cent, of this arable land was irrigated and farmed.

3. On account of the lack of sufficient water in Gila and San Carlos rivers during a certain period in summer when irrigation is most needed and on account of the difficulty of maintaining diversion dams and canals, the system of irrigation in 1914 was inadequate.

4. In the river valleys water in sufficient quantities for irrigation can probably be obtained by pumping from shallow wells in the alluvium.

5. The principal source of the water in the valley alluvium is believed to be seepage from the rivers. Consequently the largest yields may be expected from wells near the river channels.

6. In 1913 the cost of irrigating under the present system was $1.34 an acre. The cost of pumped well water would probably be higher.

7. The waters from shallow wells in the Gila Valley are heavily mineralized. They are so high in chlorine, which is one of the constituents of common salt, that they are of doubtful value for irrigation, and if used continuously they would require extraordinary precautions to prevent an excessive accumulation of alkali in the soil.

8. The shallow ground waters in the San Carlos Valley are believed to be better than those of the Gila Valley and comparable to the water from Gila River, which is now successfully used for irrigation.

9. Final judgment on the suitability of the shallow ground waters for irrigation should be deferred until their effect on crops has been determined by actual experiment.

10. To the extent that the shallow ground waters are found to be good enough for irrigation they can be advantageously used on the tracts already under cultivation to supplement the surface-water supply and on arable tracts that lie above the ditches.

11. In the Gila Basin structure favorable to artesian conditions exists on one or both sides of the valley between the east boundary of the reservation and San Carlos, and it is believed that artesian water can be obtained in the river valley between these points.

12. In the San Carlos Basin structure favorable to artesian conditions exists only on the west side adjacent to that part of the valley included within the proposed reservoir.

13. To test the water-bearing possibilities of the Gila conglomerate it will be necessary to drill through the Recent alluvium and the lake beds, which, according to the writer's estimates, have an average thickness below the river valleys of not more than 700 feet. In some places it may be necessary to drill 1,000 to 2,000 feet to test the existence of water-bearing beds.

14. The structure appears most favorable on the south side of the Gila Basin, west of Bylas. A good location for a test well would be on Dewey Flat or on the 180-acre tract of arable land 1 mile east of Dewey Flat.

15. There is no direct information as to the quality of the water in the Gila conglomerate, but it is probably good enough to be used for irrigation.

16. Unfavorable conditions may exist underground that will make it impossible to obtain artesian wells, but the conditions as observed at the surface are sufficiently favorable to warrant the drilling of a test well.

O

A.W. Ambrose

DEPARTMENT OF THE INTERIOR
FRANKLIN K. LANE, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

WATER-SUPPLY PAPER 450—B

GROUND WATER IN LANFAIR VALLEY CALIFORNIA

BY

DAVID G. THOMPSON

Prepared in cooperation with the
DEPARTMENT OF ENGINEERING OF THE STATE OF CALIFORNIA

Contributions to the hydrology of the United States, 1919
(Pages 29-50)

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CONTENTS.

ILLUSTRATIONS.

GROUND WATER IN LANFAIR VALLEY, CALIFORNIA.

By David G. Thompson.

LOCATION AND GENERAL FEATURES OF THE VALLEY.

The area described in this paper lies in the east-central part of San Bernardino County, Calif. (See Pl. V.) It is mostly a large alluvial plain, which slopes southeastward with a nearly uniform grade of about 100 feet to the mile, though its continuity is at several places broken by small buttes of lava or by granite knobs. This plain is bordered on the west and north by the Mid Hills and the New York Mountains, and on the south and east by several more or less detached mountain masses, composed principally of volcanic rocks. The largest of these detached mountains are the Piute Range, on the east, and Hackberry Mountain, on the south. The plain and the adjacent mountain slopes form a nearly inclosed drainage basin, which is outlined on Plate VI. This drainage basin includes about 325 square miles. The alluvial slopes cover about 260 square miles, or 80 per cent of the basin; the mountains cover about 65 square miles. The grade of the alluvial slopes is generally so slight as not to interfere with agriculture. The basin includes no lowland tract of nearly flat land, such as is found in the Ivanpah, Mesquite, and Pahrump valleys, to the north.

This drainage basin has been called the Barnwell Sink,[1] but this name is not appropriate, because Barnwell lies on its extreme outer edge, and it is not a "sink," for that term is commonly used in the desert region of California to designate the bottom of a closed basin in which a stream disappears either because its water is evaporated or because it sinks into the ground. It is suggested that this area be called Lanfair Valley, as most of the settlements in it are near Lanfair and as that town is not far from its center.

During the last two or three years many settlers have taken up homesteads in this valley, most of them near Lanfair, and have been

[1] Tait, C. E., Irrigation resources of southern California: Conservation Comm. California Rept., p. 824, 1912.

attempting to raise crops by dry farming. In the fall of 1 than 130 registered voters were living here. The writer vi valley in November, 1917, while he was gathering data for a desert watering places,[1] and obtained information about t supply. Although very few wells have been drilled in the va very little data were available concerning the water suppl been decided to publish this brief report because a large nu settlers have already taken up land in the valley or are pla settle there.

ROADS AND SETTLEMENTS.

Lanfair Valley is traversed from north to south by the well and Searchlight branch of the Atchison, Topeka & Sa Railway, which connects with the main transcontinental Goffs, 9 miles southeast of Vontrigger. In 1917 there was service from Goffs to Searchlight six days a week, and on S a train ran from Goffs to Ivanpah. There were small settle at Lanfair, Ledge (Maruba post office), and Barnwell, and offices at the first two places. There was a small store at La at which groceries, gasoline, and oil could be obtained. P Blackburn, and Vontrigger are merely railroad sidings, not se ments. Fair automobile roads connect the valley with the rounding country. The Ivanpah and adjoining valleys ma reached by way of Barnwell. From Lanfair a road leads to C and the Valley Wells mining region, by way of Rock Springs, G ernment Holes, and Cedar Canyon. A road leads southward, pa lel to the railroad for part of the distance, to the much-trave National Old Trails Road at Goffs. Another road leads southw ward and then southward from Government Holes to the Sa Fe Railway and the National Old Trails Road at Fenner.

ELEVATION AND DRAINAGE.

Lanfair Valley stands at a high altitude, most of it 3,500 to 5,0 feet above sea level, and two extensions of the valley west and nort west of Rock Springs rise nearly 5,500 feet above sea level. The two branch valleys reach almost to the summit of the Mid Hill which form a small range in the rim between the Providence Moun tains and the New York Mountains. At one place the almost fla surface of the southern branch valley has been slightly dissected by drainage lines that lead to Cedar Canyon. This canyon, which drains westward, has cut entirely through the former divide of the Mid Hills and is tapping the drainage of the eastern side of the mountains.

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[1] Thompson, D. G., Routes to desert watering places in San Bernardino County, Calif., and adjoining areas: U. S. Geol. Survey Water-Supply Paper — (in preparation).

The surface of Lanfair Valley has a gentle and nearly uniform outheastern slope from the head of these elevated valleys, above which the mountains, except one or two peaks, rise not more than ,000 feet.

The valley is drained at several places, principally through a wide ass 6 miles east of Blackburn, but partly through two narrow asses on the east and west sides of Hackberry Mountain. Nearly ll the drainage moves southward to a large valley that extends from Goffs southwestward to a closed basin several miles south of Cadiz (see Pl. V), the bottom of which is about 600 feet above sea level. A drainage line extends continuously from a point near Barnwell to a point several miles south of Cadiz, a distance of more than 75 miles.[1] This is one of the longest drainage lines in any closed basin in the desert region of southern California. A very small part of the drainage of the valley goes toward Colorado River by way of two canyons at its extreme eastern edge (see map, Pl. VI), where the old Government road to old Fort Mohave passes south of a small hill (marked B M 3789) 10 miles east of Lanfair. These canyons drain through Piute Wash into Colorado River a few miles north of Needles, a distance of about 30 miles. As the climate of the valley is arid and the soil is porous the rain that falls in it seldom if ever reaches the basin south of Cadiz or Colorado River as surface run-off.

GEOLOGY.

The geology of the region has not been studied in detail. The main mass of the New York Mountains and the Mid Hills is composed of granite, which is flanked on the north and northeast by metamorphosed limestone, quartzite, gneiss, and schist, into which it is intruded. The sedimentary rocks are shown on the geologic map of the State of California as of Cambrian age,[2] but Larsen has found one or two fossils in them which he believes to be Carboniferous.[3] At the south end of the Providence Mountains, near the edge of the area shown on Plate VI, the granite is intruded into limestone, which has been determined as Carboniferous.[4] The granite is part of a large intrusive mass that covers many square miles, extending at least as far as Marl Spring and Kessler Spring, west and northwest of Cima. In some of the low hills east of Blackburn and Vontrigger, granite, diorite, and altered limestone are found.[5]

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[1] Darton, N. H., Guidebook of the western United States, Part C, The Santa Fe Route: U. S. Geol. Survey Bull. 613, maps 21 and 22, 1916.

[2] Geologic map of the State of California, State Mining Bureau, 1916.

[3] Larsen, E. S., U. S. Geol. Survey, personal communication.

[4] Mines and mineral resources of San Bernardino County, p. 58, California State Min. Bur., 1917.

[5] Idem, pp. 11, 69–72. Darton, N. H., op. cit., pp. 147–148, footnote, and maps 21 and 22.

Volcanic rocks, mostly of Tertiary age, are abundant around the edges of the valley. Purplish extrusives, probably rhyolite, occur on the road between Ivanpah and Barnwell, but their full extent there is not known. Rhyolite is found in the Castle Mountains, in the Hart mining district.[1] The Piute Range, forming an imposing steep-sided mountain on the east border of the valley, is composed of volcanic rocks, as are Hackberry Mountain and the low hills west of it. The flat-topped mesas at the east foot of the Providence Mountains are composed of similar extrusives. A prominent butte 2 miles north of Government Holes appears from a distance to be composed of the same series of light-colored rhyolites, latites, and tuffs as those seen in Table Mountain and the hills south of this mountain, which have been described by Darton as of Tertiary age.[2] The extrusive rocks of Table Mountain obviously lie on the old erosion surface of the granite which forms the main mass of the New York Mountains and Mid Hills. The volcanic rocks near Barnwell and in the Castle Mountains are perhaps of the same age as those along the east and south sides of the basin, but their erosion and weathering suggest that they are somewhat older. Buttes a short distance northwest and northeast of Lanfair were not examined but are believed to be composed of rhyolite. Part of Lanfair Valley is underlain at no great depth by lava of Tertiary or Pleistocene age, which rests on older gravel, and this lava may have covered a large area. Extrusive rocks of Pleistocene age are found elsewhere in San Bernardino County at places not far distant.

The greater part of Lanfair Valley is covered with detrital materials—sand, gravel, and boulders—washed down from the mountains on the west side of the valley. The depth of the alluvial material in the center of the valley is not definitely known, but well records indicate that in places it is not very thick and that it is underlain by volcanic material, below which at no great depth there are still other beds of gravel. Moreover, the hills of granite and lava that outcrop at many places in the valley indicate that in some places at least igneous bedrock lies at no great depth beneath the gravel floor. The gravel which has been penetrated at depths of 400 to 500 feet is older than the overlying igneous rocks, and is no doubt of late Tertiary or early Pleistocene age. This gravel may possibly be correlated with the red sandstone and conglomerate that outcrop on the Santa Fe Railway near Klinefelter and at other localities between that place and Colorado River. The sandstone and

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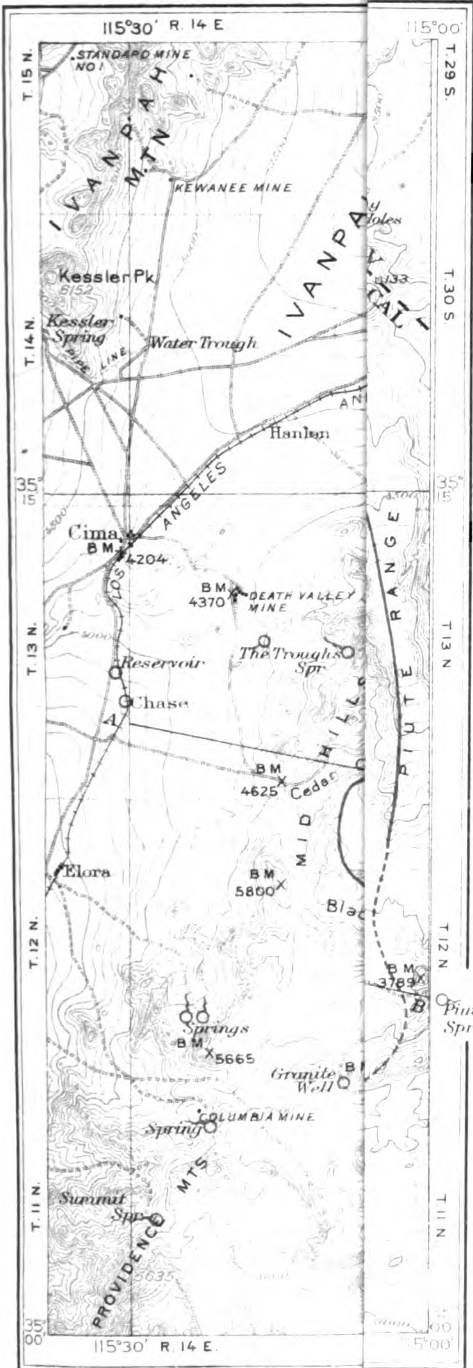
[1] Hill, J. M., The mining districts of the western United States: U. S. Geol. Survey Bull. 507, p. 128, 1912.

[2] Darton, N. H., Guidebook of the western United States, Part C, The Santa Fe Route: U. S. Geol. Survey Bull. 613, pp. 147–148, footnote, and maps 21 and 22, 1916.



Part of U. S. G. S. topographic map of Ivanpah quadrangle

TO

EXPLANATION

Boundary of Lanfair Valley

Well
(*Numbers refer to those in table*)

Spring
(*Numbers refer to those in table*)

A —— B

Line of cross section, Fig. 3

conglomerate are believed by Darton[1] to be Pleistocene. One or two miles south of Barnwell several tongues of very coarse alluvial conglomerate, the boulders of which are mainly blue quartzite, extend out from the foot of the mountains. These tongues rise 15 to 50 feet above the general level of the slope. They are apparently older than the present alluvial deposits and have been exposed by faulting along the east edge of the mountains. They are probably of Pleistocene age, and may perhaps be correlated with the gravel that underlies the volcanic materials penetrated in the wells at Lanfair.

The northwestern slopes of the New York Mountains, the Mid Hills, and the Providence Mountains are much steeper than their southeastern slopes, and their rocky walls extend 1,000 to 2,000 feet lower on their northwestern than on their southeastern side. (See fig. 3.) These differences in slope might be explained by assuming that the mountain mass on the northwest side of Lanfair Valley is a large fault block that has been uplifted on its northwest edge and tilted down on its southeast edge, but not enough is known of the geology to permit this assumption.

Another explanation of the difference in the slope of the northwest and southeast sides of the mountains is based on meager

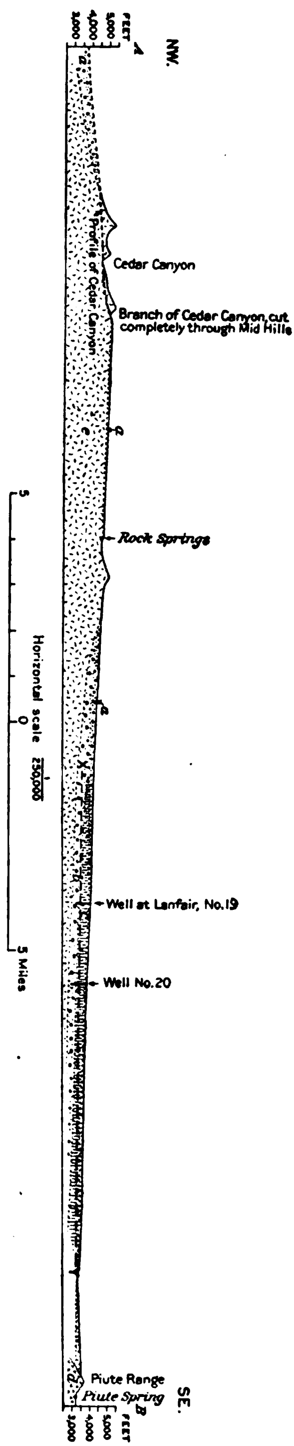


FIGURE 3.—Profile and hypothetical cross section of Lanfair Valley, Calif. *a*, Recent alluvial gravel, grading into *b*; *b*, older alluvial gravel of Pleistocene or Tertiary age; *c*, extrusives (lava, ash, etc.), Pleistocene or Tertiary, resting on *b*; *d*, volcanic rocks of Piute Range, probably Tertiary; *e*, granite of Mid Hills and New York Mountains. The volcanic rocks of the Piute Range act as a dam, west of which ground water is held under pressure. For the area east of Lanfair the dashed line X–Y marks the level to which water will probably rise in wells; for the area west of Lanfair it marks the probable depth to the water table.

[1] Darton, N. H., op. cit., pp. 146–147 and map 21.

evidence obtained from wells in Lanfair Valley. In two wells, one at Lanfair station and the other about a mile southeast of Lanfair, volcanic ash was said to have been reached at depths of 52 and 4 feet, respectively. In these wells the ash continued to depths of 520 and 410 feet, respectively, below which gravel was penetrated to a depth of 550 feet in each well. Material taken from the well at Lanfair, which was examined superficially by the writer, contained fragments of a rock that seemed to be rhyolite, although they were mixed with other materials, and there was no indication as to the depth from which the fragments of lava had come. In a well at Ledge (Maruba post office) water was reached at a depth of 365 feet and rose in the well to a point within about 100 feet of the surface. Though no information is available as to the strata penetrated in this well, the water-bearing bed is probably gravel which is overlain by a more impervious bed, perhaps volcanic rock. Volcanic rocks are abundant around the valley and form small outliers northwest and northeast of Lanfair. (See p. 32.)

These facts suggest that a thick bed of lava may occupy the valley at a comparatively slight depth below a cover of alluvial gravel, and that the lava was poured out at the time of the extrusion of the masses that form the Piute Range, Hackberry Mountain, and the buttes a short distance northwest and northeast of Lanfair. The gravel found at depths of 400 to 500 feet in the wells at Lanfair indicates that the floor of Lanfair Valley at one time stood at a much lower level, and that the southeast face of the New York Mountains and Mid Hills was probably once as precipitous as the northwest face is today. Faulting would thus not be involved in the explanation of the surface features of this large, high valley, but there has probably been much faulting in the mountains. Before the volcanic eruptions that produced the Piute Range, Hackberry Mountains, and the buttes northwest and northeast of Lanfair the area that is now Lanfair Valley was probably not so nearly inclosed as it is now. It was probably a part of a great alluvial slope that extended southeastward toward Colorado River, unbroken by the volcanic rocks that now border it on the east and south.

Lanfair Valley is limited on the east by the Piute Range, which forms a barrier that prevents the drainage from its northern part from going toward Colorado River. This range is composed of volcanic rock, is nearly flat-topped, and has almost vertical sides. It may be an uplifted fault block, or it may be a remnant of a large body of lava which was poured out on old gravel that is now deeply buried. In either case the drainage from the valley at some earlier period probably reached Colorado River. The mountains that form the southern boundary of the valley are also in large part of volcanic origin.

MINERAL RESOURCES.

A number of mines in the mountains around Lanfair Valley have een active at one time or another, but in 1917 very little mining was eing done. Gold is found in the Castle Mountains, near Hart, vhere a shaft 900 feet deep had been sunk in 1917, and about 20 men vere employed. The ore is said to be rich in spots. A mill had been uilt, but it was not being operated in the later part of 1917. Deosits of tungsten are found on the southeast side of the New York Mountains, but they have not yet been much developed.[1] Gold, coper, tungsten, and some vanadium, are found in the hills east and ortheast of Vontrigger station, and considerable mining has been lone in this district.[2]

CLIMATE.

In 1917 practically all the large number of homesteaders in Lanfair Valley were trying to raise crops by dry farming. The degree of success attained in dry farming is determined largely by natural and uncontrollable conditions of climate and soil, especially of climate. The main features of climate to be considered by the dry farmer are the average annual precipitation, the distribution of precipitation through the year, the character of the precipitation, the evaporation, and the temperature.

Unfortunately, no reliable records are available for Lanfair Valley. The United States Weather Bureau has published observations made at Jean, Nev., about 45 miles north of Lanfair; at Searchlight, Nev., 50 miles northeast of Lanfair; at Needles, Calif., about 40 miles southeast of Lanfair; and at Bagdad, Calif., about 50 miles southeast of Lanfair.[3] In addition, Mr. E. L. Lanfair kindly furnished the writer with incomplete records of precipitation at Lanfair for the period from March, 1912, to March, 1915. These records are given on page 36.

The great variation in climate within comparatively short distances in the arid regions of the Southwest, due in large measure to the influence of surface features, prevents close comparison between the climate at Lanfair and at the points mentioned above, but the records at these places afford some information of value. The average annual precipitation at these places is given in the accompanying table:

[1] Mines and mineral resources of San Bernardino County, p. 68, California State Min. Bur., 1917.
[2] Idem, pp. 11, 69–78.
[3] Climatological data for the United States, by sections; U. S. Dept. Agr. Weather Bur.

Average annual precipitation at stations in Nevada and California.[a]

Station.	Altitude above sea level in feet.	Length of record in years.	Average annual precipitation in inches.
Jean, Nev	2,864	7	[illegible]
Searchlight, Nev	3,445	4	[illegible]
Needles, Nev	477	26	[illegible]
Bagdad, Calif	784	14	[illegible]
Lanfair, Calif	4,040	3	[illegible]

[a] Based on data given in Climatological data for the United States by sections, 1914 to 1917, U. S. Dept. Agr. Weather Bur., and records for Lanfair given below.
[b] No record for one or more months in certain years. The average given is therefore probably slightly below the true facts.

A record of the precipitation at Lanfair from March, 1912, to March, 1915, furnished by Mr. Lanfair, is given in the following table:

Monthly precipitation, in inches, at Lanfair, Calif.

[Elevation about 4,040 feet.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1912	(a)	(a)	3.60	0.68	0.13	0.00	0.60	0.25	(b)	1.28	(b)	0.10	[e] 6.64
1913	0.39	[c] 2.98	(d)	(d)	(d)	(d)	1.29	1.43	0.63	(b)	1.56	(b)	[e] 8.28
1914	2.32	3.39	.53	1.01	(b)	.46	1.06	.19	2.29	3.16	(b)	(b)	[e] 14.40
1915	.30	5.70	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	......

[a] No record.
[b] It is not clear from Mr. Lanfair's record whether an absence of data for certain months indicates no precipitation or a suspension of observations; probably no precipitation.
[c] Does not include a 6-inch fall of snow on Feb. 22, which was not measured in inches of rain.
[d] It is not clear whether the absence of data for the months of March, April, May, and June, 1913, indicates no precipitation, but the nature of the record suggests that no observations were made during these months.
[e] Record for year probably incomplete.

As the record for Lanfair is not complete for any single year, it furnishes no ground for definite conclusions, but the information it gives, scant as it is, if studied in connection with the records at the Weather Bureau stations mentioned above, brings out the fact that the precipitation in Lanfair Valley is similar to that in other parts of the desert region in the following respects: (1) Most of the precipitation comes late in the fall, in the winter, and early in the spring; (2) there is great variation both in the average precipitation for any given month during a period of years and for the average annual precipitation; (3) the precipitation varies considerably from place to place on a given date. The precipitation in summer very often comes in the form of violent thunderstorms, and in one of these storms the rainfall in a few hours may be so abundant as to make up what would otherwise be a deficiency for the year, or to produce an excess of several inches above the normal annual rainfall. At another point a few miles away the storm may produce little or no precipitation. On the other hand a larger proportion of the rain seems to fall in summer at Lanfair than at the other observation stations, but this apparent difference may be due only to the fact that the record at Lanfair covers a period so short that it does not accurately represent the normal rainfall. The average annual precipitation at Lanfair, as shown by the very incomplete records given, also seems to be somewhat greater than at other observation stations within 50 miles of it.

The first table shows that in general the precipitation is greatest where the altitude is highest, and that it decreases with the decrease in altitude, a fact that accords with observations made in other parts of the United States. The moisture-laden winds, in moving across the land, rise to high altitudes in passing over mountains and other elevated regions, such as Lanfair Valley, and as the temperature of the air is decreased as it rises and its moisture-bearing capacity is therefore also decreased, its moisture is condensed and precipitated. As the winds again descend to lower levels on the leeward side of the mountains they become warmer and can absorb more moisture, so that evaporation rather than precipitation occurs. As Lanfair Valley stands at a high altitude the precipitation in it should be somewhat greater than that at the other places mentioned. Similarly, because of their greater altitude the precipitation in the New York Mountains and Mid Hills would be greater than at Lanfair, especially as the prevailing winds in the valley are from the west and as Lanfair is on the leeward side of the mountains. Settlers in the valley state that the precipitation at Lanfair is actually less than at points farther west, on the eastern slope of the mountains. In winter, especially, several inches of snow will fall in the mountains while practically no rain or snow falls at Lanfair.

Evaporation is an important element in the climate of the desert region of California, of which Lanfair Valley is a part, because of the high temperature and resulting low relative humidity and because of the frequent winds, which aid greatly in drawing moisture into the atmosphere.[1] The evaporation is very great during the summer, and is considerable even in winter. Much of the rain that falls in Lanfair Valley is doubtless evaporated within a few hours and is not available for use for agriculture.

No records of temperature at Lanfair are available, but the conditions there are probably somewhat similar to those in other parts of the desert. High temperature occurs during the day in summer, but the daily range is considerable, and the nights are cool. Because

[1] For a detailed discussion of factors involved in evaporation and the results of experiments on evaporation from water and soil surfaces, see Lee, C. H., An intensive study of the water resources of a part of Owens Valley, Calif.: U. S. Geol. Survey Water-Supply Paper 294, pp. 48–60, and accompanying diagrams, 1912.

Average annual precipitation at stations in Nevada and California.[a]

Station.	Altitude above sea level in feet.	Length of record in years.	Average annual precipitation in inches.
Jean, Nev	2,864	7	[b]3.[illegible]
Searchlight, Nev	3,445	4	[b]7.[illegible]
Needles, Nev	477	26	3.[illegible]
Bagdad, Calif	784	14	3.[illegible]
Lanfair, Calif	4,040	3	[b]9.[illegible]

[a] Based on data given in Climatological data for the United States by sections, 1914 to 1917, U. S. Dept. Agr. Weather Bur., and records for Lanfair given below.
[b] No record for one or more months in certain years. The average given is therefore probably slightly below the true facts.

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[Elevation about 4,040 feet.]

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1914	2.32	3.39	.53	1.01	(b)	.46	1.05	.19	2.29	3.16	(b)	(b)	[e] 14.40
1915	.30	5.70	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	......

[a] No record.
[b] It is not clear from Mr. Lanfair's record whether an absence of data for certain months indicates no precipitation or a suspension of observations; probably no precipitation.
[c] Does not include a 6-inch fall of snow on Feb. 22, which was not measured in inches of rain.
[d] It is not clear whether the absence of data for the months of March, April, May, and June, 1913, indicates no precipitation, but the nature of the record suggests that no observations were made during these months.
[e] Record for year probab[illegible] incomplete.

As the record fo[illegible]nfair is not complete for any single year, it furnishes no gro[illegible] conclusions, but the information it gives, scant as i[illegible] connection with the records at the Weather Bur[illegible]ned above, brings out the fact that the precipit[illegible]alley is similar to that in other part of the dese[illegible]lowing respects: (1) Most of [illegible] cipitation [illegible] the winter, and early i[illegible] (2) there [illegible] the average pre[illegible] given m[illegible] years and fo[illegible] precipi[illegible] varies [illegible] to pla[illegible]ipitat[illegible] comes [illegible] storm[illegible] what [illegible]iency [illegible] exce[illegible]he normal [illegible] othe[illegible] storm may pro[illegible]

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represent the normal rainfall. The average [illegible]
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PART OF VALLEY.

[illegible] laces in the New York Mountains
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[illegible] ng a well (No. 1),[1] 62 feet deep, in
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[1] Fo[illegible] correspond to those given on the map, Pl. VI, and in
[illegible]

of the high altitude, the maximum summer temperatures are probably not so high as those at lower levels. At Searchlight, 50 miles northeast of Lanfair, for instance, at an altitude of 3,445 feet, the maximum temperature during the years 1914 to 1917 was 104°, but at Needles, 40 miles southeast of Lanfair, at an altitude of only 447 feet, the temperature in each of the same four years reached 111° or more. The winters are comparatively mild, there being many days without frost, but low temperatures, from 10° to 20° above zero, occur occasionally. The winters at Lanfair are probably slightly colder, and frosts are probably more common than at lower levels.

The influence of the climate on the prospects of agricultural development of Lanfair Valley is considered on pages 46–48.

VEGETATION.

The vegetation of Lanfair Valley is very different from that of the Ivanpah and other valleys to the north and of the region to the south and southwest. It is characterized by an abundance of spine-bearing forms, such as the cactus commonly called cholla, which grows profusely, the yucca, known as the Spanish dagger, and the Joshua tree, or giant yucca. Arid-land grasses are also found, such as "galleta" and a form known as "grama grass." In the branch valley that lies west of Government Holes, more than 5,000 feet above sea level, there is a flourishing growth of sage brush (*Artemisia tridentata*)[1] and piñon, and probably some juniper. The creosote bush, *Covillea* (*Larrea*) *tridentata*, which is the prevailing species in most of the adjoining region, is very rare; it was noticed by the writer only on the north side of Hackberry Mountains near Blackburn and in one small tract near Ledge. Catsclaw was seen in washes just west and south of Blackburn. None of the forms indicating ground water at slight depth, such as mesquite and salt grass, were seen.

SOURCE OF GROUND WATER.

There are no permanent streams in Lanfair Valley, nor any which flow except immediately after storms. The water supply of the region is derived entirely from the rain and snow that fall in the valley and from the ground water, which is derived from precipitation. As this valley lies higher than any of the surrounding valleys it evidently receives no ground water from outside areas. The quantity of water now beneath the surface or that is now or will be available for domestic use for irrigation is limited by the amount of precipitation. No definite figures can be given to show the quantity

[1] Specimens of sagebrush collected in the field were identified by Miss Alice Eastwood, California Academy of Science, San Francisco.

of water available for use, but some significant facts may be considered.

Evaporation disposes of a large part of the rain in desert regions, such as Lanfair Valley, where much of it falls a little at a time, a few hundredths to a few tenths of an inch. The soil is usually so dry that it is seldom moistened to depths of more than an inch or two. Much of the rain evaporates soon after it falls, and only when rain falls steadily for a number of hours or when a large amount falls in a short time, as during a heavy thunderstorm, does any of it percolate deep enough to replenish the ground water.

It is only during the occasional heavy rains that some of the water becomes surface run-off. In the mountains, where there is little soil to absorb the rain and the rocks are nearly impervious, the run-off may then be considerable. On alluvial slopes, such as compose a large part of Lanfair Valley, the rather porous detrital material absorbs large amounts of water, and the run-off is relatively small. Most of the run-off from the mountains is absorbed on the alluvial slopes and even a large part of the run-off that is concentrated into definite streams eventually sinks into the alluvial material.

Only about one-fifth of Lanfair Valley is occupied by mountains. Some of the precipitation that falls on the north slope of Hackberry Mountain and the adjoining hills and the west slope of the Piute Range during heavy rains is immediately carried out of the basin as surface run-off. A number of springs in the New York Mountains and Mid Hills indicates that some of the water that is absorbed by the rocks and soil in the mountains is returned to the surface and removed by evaporation. Water is obtained at moderate depths in a number of wells in the mountains or in the wide valleys west and north of Rock Spring. Some of the precipitation in the mountains obviously does not enter the porous detrital material of the alluvial slopes but is held in pockets in the rock beneath the soil. Furthermore, water percolates into the alluvial material only when rain falls for a long time or in heavy storms, so that much of the annual rainfall does not replenish the ground-water supply.

GROUND WATER IN UPPER PART OF VALLEY.

Water is found at a number of places in the New York Mountains and Mid Hills at comparatively slight depths. At Barnwell the Rock Springs Cattle Co. has dug a well (No. 1),[1] 62 feet deep, in which water stands 48 feet from the surface. On the west side of the railroad at Barnwell there are two wells, one about 60 feet deep and the other about 90 feet deep, but the depth to water in them is not

[1] The numbers given in the text correspond to those given on the map, Pl. VI, and in the table on pp. 48–49.

known. At this station the Atchison, Topeka & Santa Fe Railway Co. in 1905 drilled a well 457 feet deep (No. 2), which is now abandoned. The depth to water in this well was 73 feet, and the supply was ample. During a pumping test of 24 hours the well furnished 20 gallons a minute. The well was probably abandoned because the water was unsuitable for use in locomotive boilers. The Lecyr well (No. 3) is dug in a sandy wash. When visited by the writer it was tightly covered and could not be measured, but the pumping equipment indicates that the depth to water is probably not great. Two miles west of Government Holes, about 200 feet northwest of the junction of the road from this place with a road leading to Cima, by way of Cedar Canyon, is a well dug in granite (No. 15). In the later part of November, 1917, the water stood 4 feet from the top of this well. A few feet west of the well was a slight depression in granite, about 15 feet in diameter, containing water about a foot deep. A mile south of this well, at the ranch of A. E. Moore, is a dug well (No. 16), 12.7 feet deep, in which the depth to water is 7.2 feet. Government Holes (No. 14) is a well 32 feet deep, dug at the foot of a granite hill. The depth to water is 15 feet. There are three shallow wells near Rock Springs, but they were not visited by the writer. The most northerly of these is the Beaty well (No. 11), which is said to be about 30 feet deep and in January, 1918, was reported to contain only 18 inches of water. The middle one of the three, called the Emdee well (No. 12), is said to be 18 feet deep and to contain 8 feet of water. The third well (No. 13) is near the shaft of the Barnett Mining Co. The depth to water is reported to be about 8 feet. The depth of the well is not definitely known but is probably about 20 feet.

The quantity of water available in any of these wells is apparently not great. The well of Mr. Moore (No. 16) yields 11 gallons a minute, and if the pumping is increased the well is pumped dry. The largest quantities pumped from the Emdee and Barnett wells are about 1,000 gallons a day each. Although the actual capacity of these wells is not known they could probably be pumped dry easily with power pumps. All the wells mentioned above that are west and southwest of Rock Springs are near the foot of granite hills, where solid rock lies close to the surface. They are apparently supplied from rain water, which percolates downward to the surface of the solid rock, along which it moves toward lower levels. If the wells mentioned were pumped heavily the water level would probably be lowered considerably, as the small tracts in which the wells are dug do not contain a sufficient supply to withstand heavy drafts.

During years of normal precipitation the water in the ground is sufficient to keep the water table rather near the surface, and in some places it returns to the surface in springs, such as Rock Springs, which are in a small canyon that heads in the wide valley west of the springs. During a series of unusually dry years the supply of ground water would probably be rapidly diminished. At the end of the dry fall of 1917, Rock Springs were practically dry, and other springs in the New York Mountains and Mid Hills were also reported to be dry.

GROUND WATER IN MAIN PART OF VALLEY.

In the main part of Lanfair Valley the depth to the water table is apparently much greater than in the marginal parts, where rock lies close to the surface and prevents the rain water from sinking to great depths. Information is available concerning only three wells drilled on the alluvial slopes that compose the surface of the greater part of the valley. As far as is known, no other wells have been drilled on these slopes. At Ledge (Maruba post office) Mrs. E. J. Jacoby has drilled a well (No. 9) 879 feet deep. Water was struck at a depth of 365 feet and rose within about 100 feet of the surface. The well furnishes about 20 gallons a minute. No log of the strata penetrated is available. At Lanfair Mr. E. L. Lanfair has drilled a well (No. 19) 550 feet deep. Gravel was penetrated to a depth of 52 feet, below which the materials encountered to a depth of 520 feet were described as volcanic ash. Fragments of the drill cuttings examined by the writer seemed to be a rhyolitic rock. A bed of water-bearing gravel was entered at a depth of 520 feet and extends to the bottom of the well. The water rose within 500 feet of the top. Mr. Lanfair has drilled another well (No. 20), also 550 feet deep, about a mile southeast of the one just described. In this well volcanic ash was struck at a depth of only 4 feet and extended to a depth of 410 feet, where gravel was found, which reached to the bottom of the well. Water was found in the gravel at 410 feet and rose 10 feet in the well.

Though the data afforded by the wells in the valley are meager they disclose three important facts:

First, the depth to water is great.

Second, the water is confined in deeply covered gravel under sufficient pressure to rise somewhat in wells when the overlying beds are penetrated, but not under sufficient pressure to rise near the surface. Unfortunately, the data available are too incomplete to suggest the heights to which the water might rise in wells drilled at different points in the valley. The conditions mentioned above, together with the occurrence of large masses of volcanic rock on the borders of the valley, indicate that a large part of the alluvial slope is underlain at a slight depth by volcanic material. (See fig. 3, p. 33.) In both of Mr. Lanfair's wells this material was reported as volcanic ash, but it may include ash, tuff, rhyolite, or other extrusive rocks.

Third, the fact that the water rose higher in the well at Ledge than in the well at Lanfair indicates that the underground conditions are not uniform throughout the valley—that some underground structure affects the ground-water level. Low hills 3½ miles northeast of Lanfair and a low ridge that extends from the Castle Mountains to a point about 4½ miles south of Hart indicate that a rock barrier may cross the deeply buried gravel in such a way as to dam the water west of these hills, so that it is held under greater pressure than the water on the lower side of the barrier.

The great depth to water in Lanfair Valley is due chiefly to the high elevation of the valley above the bottom of the basin into which it drains—the basin south of Cadiz—and to the steepness of the alluvial slope. The water in the detrital material is drained toward Goffs and thence to the basin near Cadiz. Data furnished by the Atchison, Topeka & Santa Fe Railway Co. in regard to the level of water in its wells shows that the water table in the valley both southwest and east of Goffs lies at a considerable depth. At Goffs the depth to water in 1917 was 606 feet; at Homer, in 1902, it was 608 feet; at Fenner, in 1906, it was 460 feet; and at Danby, in 1903, it was 268 feet. Thus, the conditions facilitate the draining away of any large quantity of water that might pass into the upper gravel in Lanfair Valley.

Not only is some ground water being lost by percolation toward Goffs, but some may be coming to the surface in springs. As nearly as could be ascertained Piute Spring (No. 23) is just outside of the eastern border of the area shown on the map (Pl. VI), in a canyon south of the hill marked "B. M. 3789," about 11 miles from Lanfair. This canyon has been cut back so far that it receives some drainage from Lanfair Valley. The spring was not visited by the writer, but it is said to be one of the strongest in San Bernardino County, the water flowing down the canyon for nearly a mile. This spring is below the level to which water rises in the wells at Lanfair, and the strong flow may come from the gravel, which is deeply buried at that place.

In November, 1917, several persons planned to drill wells in the near future, but as late as June, 1918, none of them had done any drilling. A number were confident that wells drilled about 3 miles west of Lanfair would find water at depths of less than 200 feet, because the surface drainage here goes southward, toward Hackberry Mountain, which, they believed, holds the ground water at a somewhat higher level than at Lanfair, it being assumed that the ground water moves in the same direction as the surface flow. The land on which these wells would be drilled lies 200 to 400 feet above the base of Hackberry Mountain, so that even if the water table on the north side of the mountain is near the surface the depth to water in the wells would still be great. Moreover, there are no indications that the water table at the foot of the mountain is close to the surface. Water does not come to the surface in the short canyon between Blackburn and Vontrigger, through which much of the surface run-off goes, nor is there any vegetation in this canyon—such as running mesquite and arrow weed—to indicate that water lies near the surface. Although the depth to the water table is doubtless much less in this canyon than at Lanfair, it is probably at least 50 feet, and at points farther northwest, up the alluvial slope, it increases. Unless some concealed structure causes the water level to stand higher here than at Lanfair, and there are no surface indications of any such barrier, the depth to water at places 3 or 4 miles west of that town will probably be fully as great as it is in the wells described.

At Lanfair the water-bearing bed slopes less steeply than the surface. If it bears the same relation to the surface in areas near the south and southeast borders of the valley, where the low mountains may tend to hold the water back, it will probably lie not so deep in these areas as at Lanfair, a probability indicated by Piute Spring, but as only a little information is available, and as that indicates that the depth to water on the alluvial slopes is great, no one should begin to drill a well unless he is prepared to go to a depth of 300 to 500 feet.

QUALITY OF WATER.

Samples of water from three wells (Nos. 3, 9, and 16 on Pl. VI) in Lanfair Valley were collected by the writer and were analyzed in the water-resources laboratory of the United States Geological Survey. An analysis of water from a well (No. 2) drilled at Barnwell by the Atchison, Topeka & Santa Fe Railway Co. but now abandoned was furnished by that company. The results of the analyses are given in tables on page 50, where the waters are classified according to their quality for domestic, boiler, and irrigation use.[1]

The suitability of a water for domestic use depends on its acceptability for drinking, washing, and cooking. Hard waters can be used for drinking but are unsatisfactory for cooking and especially for washing. Waters whose hardness exceeds 200 parts per million (in terms of $CaCO_3$) are not satisfactory for washing. Waters whose hardness exceeds 1,500 parts per million are undesirable for cooking. The presence of approximately 200 parts per million of the normal

[1] See Mendenhall, W. C., Dole, R. B., and Stabler, Herman, Ground water in San Joaquin Valley, Calif.: U. S. Geol. Survey Water-Supply Paper 398, pp. 56–58, 65–69, 73–82, 1916, for a detailed discussion of the classification of waters for different uses.

carbonate radicle, 250 parts of the chloride radicle, or 300 parts of the sulphate radicle, can be detected by taste. Waters that contain considerably more of these constituents can be tolerated by a human being, but those that contain more than 300 parts per million of the carbonate radicle, 1,500 parts of the chloride radicle, or 2,000 parts of the sulphate radicle are intolerable to most people. Local conditions and individual preference, however, largely determine the significance of the terms "good" or "bad" as applied to the mineral quality of water for domestic use. In a desert region a water having 240 parts per million of hardness (expressed as $CaCO_3$) might be classed as fair; in a region where the supply is abundant and the general quality is much better, as in the New England States, the same water would by most users be classed as bad. It should be borne in mind that in this report the classification of a water for domestic use is based only on its mineral content; it does not indicate the sanitary quality of the water. A water may contain only 100 parts per million of total solids in solution and yet be so badly polluted as to be unfit for drinking.

With respect to their quality for use in boilers, waters are classified according to the amounts of their scale-forming (incrusting) and foaming constituents and the probability of corrosion. The following rating of boiler waters is adapted from that suggested by the American Railway Engineering and Maintenance of Way Association, but the amounts are recomputed to parts per million.

Ratings of waters for boiler use according to proportions of incrusting and corroding constituents and according to foaming constituents.

Incrusting and corroding constituents.		Foaming constituents.	
Parts per million.	Classification.[a]	Parts per million.	Classification.[b]
Less than 90	Good	Less than 150	Good.
91 to 200	Fair	151 to 250	Fair.
201 to 430	Poor	251 to 400	Bad.
More than 430	Bad	More than 400	Very bad.

[a] Am. Ry. Eng. and Maintenance of Way Assoc. Proc., vol. 5, p. 595, 1904.
[b] Idem, vol. 9, p. 134, 1908.

With respect to their value for irrigation, waters are classified according to their content of alkaline salts. Water containing large quantities of alkaline salts is injurious to vegetation because, through evaporation, the alkali[1] collects in the few inches of top soil in quantities so large as to interfere greatly with the growth of plants. The value of a water for irrigation as determined by the

[1] The term "alkali" is used to designate the common soluble salts formed on the evaporation of natural waters. Sodium carbonate (sal soda), or "black alkali," and sodium sulphate (Glauber's salt) and sodium chloride (table salt), or "white alkalies," are the principal alkaline salts.

amount of alkali it contains is expressed by its "alkali coefficient,"[1] which is defined as the depth of water in inches which, on evaporation, would yield sufficient alkali to render the soil to a depth of 4 feet injurious to the most sensitive crops. The alkali coefficient affords a purely arbitrary means of comparing waters used for irrigation. It does not take account of the methods of irrigation and of drainage, the character of the soil, and the kind of crop, but it indicates very well the general suitability of any water for irrigation. The waters in the areas here discussed have been classified as to quality for irrigation in accordance with the following rating:

Classification of water for irrigation.[a]

Alkali coefficient (inches).	Class.	Remarks.
More than 18	Good	Waters have been used successfully for many years without special care to prevent accumulation of alkali.
18 to 6	Fair	Special care to prevent gradual accumulation of alkali has generally been found necessary except on loose soils with free drainage.
5.9 to 1.2	Poor	Care in selecting soils has been imperative and artificial drainage has frequently been found necessary.
Less than 1.2	Bad	Waters practically valueless for irrigation.

[a] Stabler, Herman, Some stream waters of the western United States, with chapters on sediment carried by the Rio Grande and the industrial application of water analyses: U. S. Geol. Survey Water-Supply Paper 274, p. 179, 1911. See also U. S. Geol. Survey Water-Supply Paper 398, p. 57, 1916.

The waters analyzed range in total content of solids from 229 to 1,992 parts per million, but three of them contain less than one-half as much mineral matter as the fourth. The most highly mineralized water, that from the Lecyr well (No. 3), is used only for cattle. The classification shows that the water from the Lecyr well is bad for domestic use because of its extreme hardness and its high content of sulphate. It would be considered unfit for use in boilers on account of its tendency to form scale and to foam, and it could not be improved economically by chemical treatment. It has, however, been classed as fair for irrigation. It is essentially a calcium-sulphate water, such as is found near gypsum deposits, although no such deposits are known to exist in the region.

The water from the well of Mrs. E. J. Jacoby, at Ledge (No. 9), is good for domestic use and for irrigation but is of only fair quality for use in boilers because of its rather large content of scale-forming constituents. This water comes from a depth of about 365 feet. The water from the deep wells at Lanfair is probably somewhat similar to it.

The water from the well of A. E. Moore (No. 16), the only other water used for domestic purposes, is of fair quality for drinking and

[1] Stabler, Herman, Some stream waters of the western United States, with chapters on sediment carried by the Rio Grande and the industrial application of water analyses: U. S. Geol. Survey Water-Supply Paper 274, pp. 177–179, 1911.

cooking but will cause trouble in washing because of its hardness. It is poor for boiler use because of its high content of scale-forming and foaming constituents, and it might possibly corrode boilers. This sample probably represents the water obtained from shallow wells in the high valleys on the western edge of Lanfair Valley.

The water from the abandoned well of the Atchison, Topeka & Santa Fe Railway at Barnwell (No. 2) is of fair quality for drinking and cooking, but because of its hardness it is not very satisfactory for washing. It is bad for boiler use because of its large amount of scale-forming constituents and its tendency to corrode boilers. The well was probably abandoned because its water was of poor quality for use in locomotive boilers.

The results of the four available analyses of water from wells in this valley appear to show that the ground water is satisfactory for use in irrigation.

WATER SUPPLY FOR AGRICULTURE.

Although many homesteaders were living about Lanfair in 1917, only three of them possessed their own domestic water supplies. The others were forced to haul water for all purposes, often having to pay for it. A number of them hauled water from the wells west of Rock Springs and from springs in the mountains. Some of the springs are controlled by a large cattle company and there has been friction between the ranchers and the cattlemen over the water.

Most of the settlers have attempted dry farming. The crops that have been tried include milo maize, varieties of field corn, and beans. The small grains have been sown in the fall, and the corn and beans in the spring. Some fair crops have been obtained, the most successful of which were grown well up on the alluvial slope, a short distance east of Rock Springs—that is, in that part of the valley where the rainfall is usually greatest because of the influence of the mountains. None of the crops have proved as successful as had been hoped.

Success in dry farming depends upon the knowledge and skill that may be called technique [1] and upon climatic conditions—such as the average annual precipitation, the seasonal distribution of precipitation, the nature of the precipitation (that is, in heavy showers or in small amounts), and the evaporation—and on the soil, the nature of which determines the quantity of water that enters the ground. These have already been considered (pp. 35–39).

[1] Clothier, R. W., Dry farming in the arid Southwest: Univ. Arizona Agr. Exper. Sta. Bull. 70, 1913. This paper discusses the methods of dry farming and gives the results of experiments in Arizona. It contains much valuable information for the prospective dry farmer.

Incomplete records at Lanfair for short periods give an average annual precipitation of less than 10 inches, and longer records for the region around Lanfair Valley show that the average annual precipitation is probably not more than this amount. Dry farming has generally been considered impracticable where the precipitation is as low as 10 inches and where the evaporation is as great as it doubtless is in Lanfair Valley.[1] The rainfall at Lanfair, as shown in the table on page 36, is not confined principally to any season but is distributed through the year, some of it coming when it can do no appreciable good. The record for the years 1912, 1913, and 1914 shows that from 17 to 33 per cent of the annual precipitation came in amounts of less than half an inch in 24 hours. These light showers add very little water to the soil, although they may help plants that are growing.[2] On the other hand, some of the rain falls in heavy thundershowers, when it may do more damage than good.

Unfortunately, the climatic observations in Lanfair Valley are very imperfect and are not strictly reliable. They cover a period so short that they are not of much value to any one who is trying to reach conclusions as to the possibility of carrying on successful dry farming. The prospects of the dry farmer in the valley do not seem to be very good. At the best, he will be laboring precariously in that borderland which separates success from failure. Fair crops may be raised in the wettest years, and possibly in years of normal precipitation, but it is certain there will be years when the rainfall is so deficient that crops will fail. Those who attempt to develop this valley by dry farming should have sufficient financial backing to carry them over a number of years, and until they can prove that crops can be raised without irrigation they should consider their work an experiment.

Only a little irrigation has been attempted in Lanfair Valley. Mrs. E. J. Jacoby has used water from her well at Ledge to irrigate about an acre of melons and garden truck. Mr. A. E. Moore has irrigated a few fruit trees at his ranch, 2 miles southwest of Government Holes (well No. 16, Pl. VI), but he states that the climate is too uncertain early in the spring to allow the trees to thrive. Mr. Moore used water from a shallow dug well, which yields about 11 gallons a minute. In the high valleys west and northwest of Rock Springs the supply from the shallow wells is doubtless sufficient for household use and for the irrigation of small tracts, but it would be insufficient to irrigate a large tract. In this part of the region, however, because of the high altitude, the precipitation is probably con-

[1] Briggs, L. J., and Beltz, J. O., Dry farming in relation to rainfall and evaporation: U. S. Dept. Agr. Bur. Plant Industry Bull. 188, p. 8, 1911. This bulletin deals with the conditions affecting dry farming that are not within the control of the farmer and that should be understood by him.

[2] Idem, p. 15.

siderable, so that if proper methods are used a large amount of water would not be required. The water from Vontrigger Spring (No. 22) was used in 1917 by Mrs. M. L. White to irrigate about 140 peach, apple, and other fruit trees, and some grapes on her ranch half a mile south of the spring. The spring fills in about 60 hours a concrete reservoir having a capacity of about 20,000 gallons. In November, 1917, the trees had been planted 2½ years and had produced good fruit. Mr. Lanfair, who owns the well at Lanfair and the well about a mile southeast of it, expected to irrigate a few acres in 1918 with water from a spring in the mountains 8 miles west of his ranch. The water is piped to a concrete reservoir near the railroad, having a capacity of about 15,000 gallons. The spring furnishes about 1,000 gallons a day.

The ground water in the valley seems to be satisfactory for irrigation, but the supply is apparently nowhere sufficient, and the cost of the high lift required to bring the water to the surface in the main part of the valley prohibits its use for irrigation, except possibly for especially valuable crops, such as garden produce or fruit trees. The conditions are not favorable for the development of practical irrigation. Wells for domestic supply and for watering stock can probably be obtained throughout the valley, but because of the great depth to which they must be drilled their cost will be rather great.

WELL DATA AND ANALYSES.

Data in regard to the wells in Lanfair Valley and the results of analyses of water from four wells, with a classification of the waters for domestic, boiler, and irrigation use, are given in the following pages:

Record of wells and springs in Lanfair Valley, Calif.

Number on Pl. VI.	Location. T.	Location. R.	Location. Sec.[a]	Owner of well or name of spring.	Depth of well.	Depth to water level in well, Nov., 1917.	Remarks.
					Feet.	*Feet.*	
1	14 N.	16 E.	[b] 13 (?)	Rock Springs Cattle Co.	62	48	At Barnwell; equipped with windmill.
2	14 N.	16 E.	[b] 13 (?)	Atchison, Topeka & Santa Fe Ry.	[c] 457	[c] 73	At Barnwell; drilled in 1903. Abandoned. See analysis on p. 50.
3	14 N.	16 E.	[b] 23 (?)	Lecyr well (controlled by Rock Springs Cattle Co.)			Dug well, located in a wash, about 1½ miles southwest of Barnwell; equipped with galvanized iron tank, concrete water trough, and windmill. Pumps at least 12 gallons a minute. See analyses, p. 50.

[a] Field investigations of the United States General Land Office show that great errors have been made in the location of the township lines in Lanfair Valley. The lines shown on Plate II are probably not accurate, but as the true positions of the lines are not known, the locations are referred to the lines shown on the map.

[b] On unsurveyed land. The location given is only approximate, according to imaginary lines continued from the township and range lines in the vicinity of Lanfair.

[c] Depth to water and depth of well not measured.

Record of wells and springs in Lanfair Valley, Calif.—Continued.

Number on Pl. VI.	Location. T.	Location. R.	Location. Sec.[a]	Owner of well or name of spring.	Depth of well.	Depth to water level in well, Nov., 1917.	Remarks.
					Feet.	*Feet.*	
4	14 N.	16 E.	[b] 29 (?)	Spring			
5	14 N.	16 E.	[b] 27 (?)	Mail Spring			
6	13 N.	16 E.	[b] 5 (?)	Spring			
7	13 N.	15 E.	[b] 2 (?)	.....do			
8	13 N.	16 E.	[b] 18 (?)	.....do			
9	13 N.	17 E.	S. ½ 18 [c]	Mrs. E. J Jacoby	[d] 879	[d] 100	12-inch drilled well at Ledge. Water reached at 365 feet; rose in well to 100 feet from surface. No solid rock encountered. Capacity, 11,000 gallons in 10 hours. See analysis, p. 50.
10	12 N.	15 E.	[b] 1 (?)	Rock Springs, controlled by Rock Springs Cattle Co.			Water comes from between granite boulders in a wash. Probably supplied by shallow ground-water flow. Nearly dry in January, 1918.
11	12 N.	15 E.	[b] 1 (?)	Beaty well	[d] 30 (?)	[d] 29 (?)	Dug.
12	12 N.	15 E.	[b] 1 (?)	Emdee well	[d] 18 (?)	[d] 8 (?)	Dug. Reported to supply 25 barrels a day.
13	12 N.	15 E.	[b] 12 (?)	Barnett Mining Co.	[d] 20 (?)	[d] 8 (?)	Do.
14	12 N.	15 E.	[b] 3 (?)	Government Holes, owned by Rock Springs Cattle Co.	32	15	Dug well. Equipped with small engine.
15	12 N.	15 E.	[b] 5 (?)			4	Shallow dug well at foot of low granite knob. A small pond stands near it.
16	12 N.	15 E.	[b] 16 (?)	A. E. Moore	13	7	Dug. Supplies 11 gallons a minute. See analysis, p. 50.
17	12 N.	15 E.	[b] 23 (?)	Spring			
18	12 N.	15 E.	[b] 25 (?)	.....do			
19	12 N.	17 E.	SW. ¼ 8 [c]	E. L. Lanfair	[d] 550	[d] 500	6-inch drilled well. Water struck at 520 feet; rose to 500 feet. Gravel, 0 to 52 feet; volcanic ash, 52 to 520 feet; gravel, 520 to 550 feet. Supplies 16 gallons a minute.
20	12 N.	17 E.	SW. ¼ 16 [c]	.....do	[d] 550	[d] 400	10-inch drilled well. Gravel, 0 to 4 feet; volcanic ash, 4 to 410 feet; gravel, 410 to 550 feet. Supplies about 35 gallons a minute.
21	11 N.	17 E.	7 (?)	Hackberry Spring, controlled by Rock Springs Cattle Co.			Water is diverted into two pipe lines. A pipe at a cattle trough 1½ miles northwest of Blackburn flowed 3½ gallons a minute from a 1½-inch pipe in November, 1917, probably not maximum flow of spring.
22	11 N.	17 E.	3 (?)	Vontrigger Spring, owned by Mrs. M. L. White.			Flows about 5 gallons a minute. Used for irrigating fruit trees.
23	12 N.	19 E.	19 (?)	Piute Spring			Said to be a strong spring.

[a] Field investigations of the United States General Land Office show that great errors have been made in the location of the township lines in Lanfair Valley. The lines shown on Plate II are probably not accurate, but as the true positions of the lines are not known, the locations are referred to the lines shown on the map.
[b] On unsurveyed land. The location is only approximate, according to imaginary lines continued from the township and range lines in the vicinity of Lanfair.
[c] Location given by the owner.
[d] Depth to water and depth of well not measured.

Mineral analyses and classification of ground waters in Lenfair Valley.

[Parts per million except as otherwise designated. Numbers at heads of columns refer to corresponding well numbers on Plate VI, and in table on pages 48–49.]

	2	3	9	16
Quantities determined:				
Silica (SiO_2)	14	32	32	36
Iron (Fe)		.50	.20	.19
Calcium (Ca)	134	308	35	88
Magnesium (Mg)	50	74	7.0	28
Sodium and potassium (Na+K)	71	[a] 172	[a] 35	[a] 126
Carbonate radicle (CO_3)	.0	.0	.0	.0
Bicarbonate radicle (HCO_3)	332	186	173	422
Sulphate radicle (SO_4)	308	1,006	28	152
Chloride radicle (Cl)	117	175	19	84
Nitrate radicle (NO_3)		.08	.08	.31
Total dissolved solids at 180° C.[b]	782	1,902	220	731
Quantities computed: [c]				
Total hardness as $CaCO_3$	540	1,070	116	350
Scale-forming constituents	490	1,100	150	340
Foaming constituents	190	460	94	340
Alkali coefficient (inches)	17	11	35	19
Classification: [c]				
Mineral content	High.	High.	Moderate.	High.
Chemical character	Ca-CO_3	Ca-SO_4	Ca-CO_3	Na-CO_3
Probability of corrosion [d]	(?)	C	N	(?)
Quality for boiler use	Bad.	Unfit.	Fair.	Poor.
Quality for domestic use	[e] Poor.	[e] Bad.	[e] Good.	[e] Poor.
Quality for irrigation	Fair.	Fair.	Good.	Good.
Date of collection	Mar. 23, 1908.	Nov. 5, 1917.	Nov. 5, 1917.	Nov. 22, 1917.
Analyst	([f])	C. H. Kidwell.	F. E. Keating.	F. E. Keating.

[a] Computed.
[b] By summation.
[c] See pages 43–46.
[d] C=corrosive; N=noncorrosive; (?)=corrosion uncertain or doubtful.
[e] Classification for domestic use based on mineral composition only; sanitary quality not determined. See p. 43.
[f] Analysis furnished by Atchison, Topeka & Santa Fe Railway Co., Arizona division, water analysis No. 4560; recalculated from hypothetical combination in grains per U. S. gallon. This water contains 5.1 parts per million of free CO_2.

DEPARTMENT OF THE INTERIOR
JOHN BARTON PAYNE, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

Water-Supply Paper 450—C

GROUND WATER IN PAHRUMP, MESQUITE, AND IVANPAH VALLEYS NEVADA AND CALIFORNIA

BY

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ILLUSTRATIONS.

INSERT.

GROUND WATER IN PAHRUMP, MESQUITE, AND IVANPAH VALLEYS, NEVADA AND CALIFORNIA.

By Gerald A. Waring.

INTRODUCTION.

In eastern California and southern Nevada there are numerous detached drainage basins that have no outlets for their surface water. The lowest parts of these basins are occupied by clay flats which may be covered with water during wet seasons but which are dry during the greater part of the year. These flats are known as playas or "dry lakes." Pahrump, Mesquite, and Ivanpah valleys occupy three such inclosed basins, partly in Nevada and partly in California. (See Pls. VII and VIII.)

The drainage basin of Pahrump Valley is mainly in Nye and Clark counties, Nev.; a small portion of it lies in Inyo and San Bernardino counties, Calif. (See Pl. VIII.) Somewhat less than half of the drainage basin of Mesquite Valley lies in Clark County, Nev., and the remainder is in California, chiefly in San Bernardino County but partly in Inyo County. About 57 per cent of the drainage basin of Ivanpah Valley is in San Bernardino County, Calif., but the lowland as well as the bordering slopes extends northward into Clark County, Nev. The areas of the drainage basins of Pahrump, Mesquite, and Ivanpah valleys, by planimetric measurement on the topographic maps of the region, are, respectively, 1,040, 395, and 770 square miles.

There are no perennial streams of consequence in any of the basins, but numerous small springs furnish water supplies for prospectors and for range stock, and at two places in Pahrump Valley there are large springs used for irrigation. Within the last few years attempts have been made in each valley to develop supplies of water for irrigation by sinking wells. Although the preliminary tests did not result in agricultural settlement of the valley lands, attempts to develop ground water for irrigation have been continued, and the writer was assigned to make a short examination of the region, in order to determine, if possible, the relative amount of ground water available and its adaptability to successful farming. A short time in August, 1916, was spent by the writer in the examination of the valleys, in company with Ernest L. Neill, of Stanford Un who rendered able assistance in gathering information. Th tion of well records and other data during the short time th be spent in the region was greatly facilitated in Pahrump V Messrs. T. G. Darrough, J. M. Raycroft, Albert Quill, Ho Vetter, and T. J. Donovan; in Mesquite Valley by Mr. J. B. and in Ivanpah Valley by Mr. Ruben Fuchner. Some ad data were collected in 1917 by D. G. Thompson, of the Unite Geological Survey.

Ivanpah Valley is traversed by the Los Angeles & Salt La road. At Cima, Ivanpah, and Nipton there are small sto limited accommodations for travelers. Roach, a settlement o dozen houses, is a shipping point for ore and affords meals commodations for the night. Jean, the principal settlement valley, is a mining supply and shipping point, with a large store, warehouse, post office, hotel, saloon, and a dozen d houses. From Jean a narrow-gage railroad extends northwe to the mining settlement of Good Springs, which in 1916 had a lation of perhaps 200, and to the Yellow Pine or Bybee mine, farther west. From Good Springs and Roach well-graded roads extend to Platina, in Mesquite Valley. This town, whic started in 1914 during local excitement over the discovery of num in the adjacent hills, consisted in 1916 of a general sto post office and seven other houses along streets laid out about a ter of a mile north of the former Ripley post office and an distance southeast of the abandoned mill of Sandy. The stor post office were discontinued, and the town was practically aband At the Milford mine and other mines in the mountains ea Platina there were small groups of tents and cabins of tho gaged in getting out ore. From Platina roads lead northwestwa Manse and Pahrump ranches, the principal settlements in Pah Valley. In 1916 Pahrump post office had mail service three ti week with Shoshone, a station 27½ miles to the southwest, on the T pah & Tidewater Railroad. The small mining settlement of Jo is near the north border of the Pahrump Valley.

The old copper smelter at Valley Wells, 20 miles northwe Cima, was rebuilt by the Ivanpah Copper Co. late in 1917, and in operation as late as February, 1918, when about 50 men were w ing there. The smelter was later reported to have been closed d Because of fluctuations of the metal market and other conditions future of many mining camps is very uncertain, and a traveler is going into a region for the first time should make inquiries reg ing the presence of settlers and not depend on finding peopl places where settlements have flourished in the past.

GEOGRAPHIC SKETCH.

TOPOGRAPHY.

Spring Mountain, a range that culminates in Charleston Peak, at an elevation of 11,910 feet above sea level, is the dominant topographic feature of the region. The east side of the range is characterized by great cliffs. The west side, which is in the Pahrump drainage basin, is somewhat less precipitous and is bordered by extensive alluvial slopes. (See Pl. IX, *A*.) The lowest part of the Pahrump basin is in the northwest, in a reentrant known as Stewart Valley (Pl. IX, *B*), at an elevation of about 2,450 feet. The southwest border of the Pahrump basin is formed by the steep slopes of the Nopah Range, which rises 2,000 feet above the valley, and by subsidiary ranges to the north and south. The drainage divide between the Pahrump basin and that of Ash Meadows, to the northwest, follows the crests of several semidetached, unnamed mountains that attain elevations of 4,000 to 5,000 feet above sea level. On the southeast the Pahrump basin is separated from the Mesquite basin by a drainage divide that extends from the crest of Spring Mountain down the alluvial slopes and across the lowland as an indefinite divide, to the base of a northeastern spur of the Kingston Range.

The Mesquite drainage basin, which is rudely triangular, has its northern, southern, and western corners, respectively, near Potosi Mountain, Clark Mountain, and Kingston Peak. The highest point in the basin is Potosi Mountain, at an elevation of 8,500 feet above sea level; the lowest land is in the dry Mesquite Lake, at an elevation of about 2,535 feet. The divide on the east is formed by a southward extension of Spring Mountain; on the southwest by lower mountains. Between spurs of these mountain ranges on the east and the southwest, wide alluvial slopes extend down to the lower land at grades of 100 to 400 feet to the mile.

The western border of the Ivanpah drainage basin, which lies south of Mesquite basin, is formed by Clark Mountain (elevation, 7,903 feet) and adjacent ranges, and by Ivanpah Mountain, whose main peaks are more than 5,500 feet above sea level. On the east the limit of the drainage basin is formed in part by the crest of the Bird Spring Range, Sheep Mountain, and the McCullough Range. From the south end of the McCullough Range the divide swings southwestward along the crest of the New York Mountains. The extreme northern limit of the Ivanpah basin is definitely marked by the summit of Potosi Mountain. The extreme southwestern limit is less definitely determined by alluvial slopes on each side of the railroad pass at Cima. The lowest portion of the basin is occupied by the dry Ivanpah Lake, at an elevation of 2,595 feet, separated by a slight divide from the dry lake near Roach, whose surface is 13 feet higher.

The surface in each basin may be divided into three parts—lowland, alluvial slopes, and mountains. The approximate areas and percentages of each class are shown in the following table:

Area of land of different classes in Pahrump, Mesquite, and Ivanpah basins.

	Lowlands.		Alluvial slopes.		Mountains.		Total area of basin (square miles).
	Area (square miles).	Per cent of total area.	Area (square miles).	Per cent of total area.	Area (square miles).	Per cent of total area.	
Pahrump basin	250	24	330	32	460	44	1,040
Mesquite basin	90	23	115	29	190	48	395
Ivanpah basin	85	11	375	49	310	40	770

It will be noted that the proportion of lowland, alluvial slopes, and mountains are approximately the same in the Pahrump and Mesquite basins, but that the Ivanpah basin contains a much larger percentage of alluvial slopes than either of the other two basins, and less than half as large a percentage of lowland.

CLIMATE.

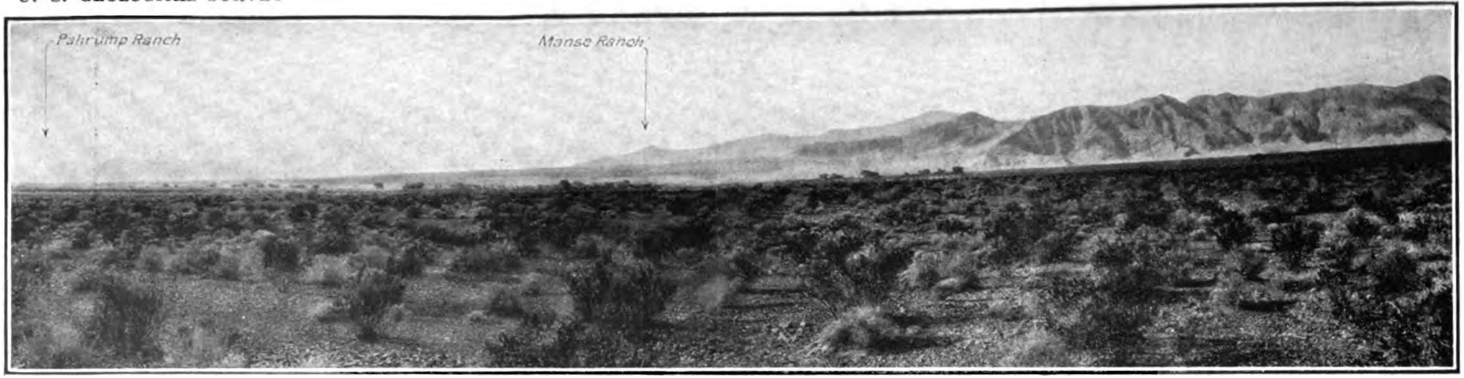
Most of the precipitation is in the winter. More than half of it falls during the four months December to March, inclusive. On the mountains much of the precipitation is in the form of snow. Occasional thunderstorms during the summer locally furnish considerable water, but they are so irregular in occurrence and are likely to be so severe that they are of relatively small value to growing crops. The following record of precipitation at Jean, in Ivanpah Valley, and at Pahrump, in Pahrump Valley, indicate the approximate monthly distribution of the precipitation in the valleys. The precipitation increases rapidly with increase of elevation.

Monthly and annual precipitation, in inches, at Jean, Nev.

[Elevation 2,864 feet.]

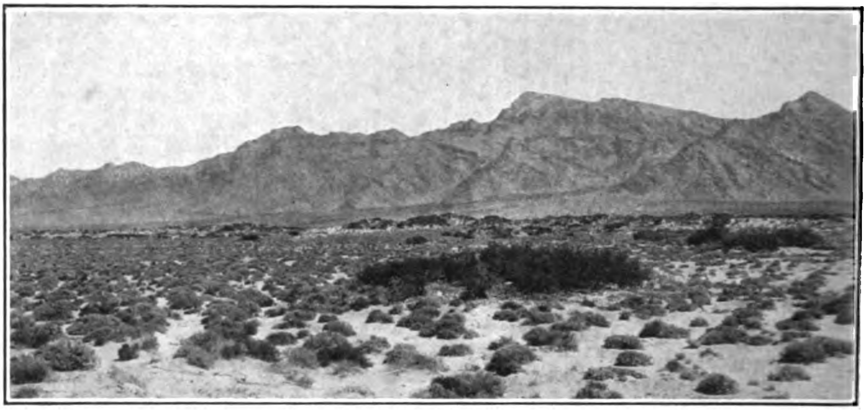
Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1908	1.30	0.10	0.20	0	Tr.	0	0.10	0.06	2.71	1.00	0	0	5.47
1909	.09	......	1.32	0.30	0	0	.03	.12	2.03	0	0.67	1.59	a 6.15
1910	0	0	0	0	0	0	2.05	1.13	.40	.60	.90	......	a 5.06
1911	.44	.75	1.00	0	0	......	Tr.	0	0	......	0	Tr.	a 2.19
1912	0	0	......	.27	.10	Tr.	.46	.20	0	.30	0	0	a 1.33
1913	.30	.40	......	.25	0	Tr.	......	.52	.23	Tr.	1.25	0	a 2.95
1914	1.50	.05	Tr.	1.25	0	Tr.	.03	0	.65	......	......	......	a 3.48
1915	1.25	1.00	.20	Tr.	Tr.	Tr.	.29	Tr.	......	......	......	......	......
1916	......	......	......	......	......	......	......	......	......	......	......	......	......

a Approximate.



A. ALLUVIAL SLOPE ON EAST SIDE OF PAHRUMP VALLEY, NEV., LOOKING NORTH.

B. STEWART VALLEY, NEV.-CALIF., LOOKING NORTH.



A. SAND RIDGES ON SOUTHEAST SIDE OF MESQUITE LAKE, CALIF., AND ALLUVIAL FANS ALONG EAST BORDER OF MESQUITE VALLEY.

B. CLAY HUMMOCKS IN SOUTHEASTERN PART OF MESQUITE LAKE.

C. CLAY BEDS AND ESCARPMENT AT J. B. YOUNT'S RANCH, PAHRUMP VALLEY, NEV.-CALIF.

Monthly precipitation, in inches, at Pahrump, Nev.

[Elevation 2,608 feet.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1914	......	......	0.14	1.56	Tr.	0.09	......	0.02	0.42	0.05	0	1.01
1915	1.20	1.40	......	......	......	......	......	......	......	......	......	......
1916	......	......	......	......	......	......	0.64	0.42	0	......	0	0.58

The extremes in temperature are great. In the valleys there are usually frosts during November to March, and in the mountains temperatures near zero are common during these months. Snow does not lie on the mountains very long in the spring, however.

VEGETATION.

The higher mountains are sparsely clothed with junipers, which in some portions are sufficiently numerous to form wooded areas. (See Pl. VIII.) The higher part of Spring Mountain also supports yellow pine and piñon, which have been to a large extent cut for lumber for the neighboring mines. The lower parts of the mountains and the extensive alluvial slopes are covered chiefly by creosote bush (*Covillea tridentata*), several species of greasewood (*Sarcobatus*), rabbit brush or rayless golden rod (*Chrysothamnus graveolens*), cactus, and yucca. Sagebrush (*Artemisia tridentata*) was not observed by the writer in any of the basins, but it is found in the elevated valleys east and north of Government Holes, 10 miles southeast of Cima.

In the southwestern part of the Ivanpah basin the giant yucca or Joshua tree (*Yucca* or *Clistoyucca arborescens*) is abundant on the slopes north of Cima, with an undergrowth of creosote bush and greasewood. On the southeast side of the basin the yucca is less common, and it does not descend much below an elevation of 3,000 feet above sea level. In the northern part of the basin, on the slopes of State Line Pass and west of Borax and Jean, a smaller yucca, either a stunted form of the Joshua tree or a related form, is fairly plentiful. The slopes below 2,800 feet are dominated by creosote bush and greasewood down to the flatland bordering the dry lakes. The larger of the two "dry lakes" in Ivanpah Valley is bordered by a zone 200 to 400 yards wide that is occupied by greasewood almost to the exclusion of creosote bush. The smaller lake bed near Roach is bordered by a zone of rabbit brush and stunted greasewood, extending to the base of the alluvial slopes, where the creosote bush becomes dominant. The lake beds themselves are barren of vegetation and during most of the year have hard, level clay surfaces. During storms they may be covered by water to a depth of several inches.

Mesquite Lake is surrounded by a belt of mesquite trees in some places 100 yards or more in width. Sand ridges on the east side of the lake bed (Pl. X, *A*) are also in part covered by mesquite. The lake bed is largely crusted with alkaline deposits that are barren of vegetation, and a part of the east side consists of a barren clay flat, dotted with clay hummocks (Pl. X, *B*), some of which are more than 15 feet high, but in some portions of the lake bed there are sparse growths of salt grass and other alkali-resistant plants.

In the Pahrump basin mesquite grows along the east side of Stewart Valley, and there are groups of the mesquite trees near Sixmile, Mound, Stump, and other springs. On the lower slopes a yucca, smaller than the average Joshua tree but resembling it, is the most prominent plant, though scattered clumps of stunted greasewood and creosote bush form the principal growth. Along the upper borders of the alluvial slopes an occasional barrel cactus is found. The lake bed southwest of Mound Spring is a barren clay flat, but that of Stewart Valley is covered by salt grass.

ANIMAL LIFE.

Wild animals are not plentiful in this region. Occasionally a coyote or a jack rabbit may be seen, and during the evening or early morning a small variety of swift or fox is abroad, hunting for desert rats. These rats and the lizards are the most common forms of wild life. On the higher slopes, especially in the wooded portions of the mountains, a few birds may be found, but the region as a whole does not furnish much food for animal life. The smaller animals are by no means so common in this region as they are farther west, where in some of the recently homesteaded valleys they are so numerous that rabbit-tight fences are almost essential to the production of crops.

MINERAL RESOURCES.

Mining has been carried on in the mountains of the region for many years. Probably the first production came from the Potosi mine, near the north border of the Mesquite basin, where lead was obtained by the Mormons about 1860. Later ores of gold, silver, copper, and lead were discovered; and in 1906 a material that accompanies some of the lead ores and had been considered to be country rock was recognized by a mining engineer to be an ore of zinc.[1]

In 1914 platinum and palladium were recognized in a gold ore from the Boss mine (3 miles northeast of Ripley), which was an old property, originally developed for copper.[2] One result of the mining rush that followed was the establishment of the town of Platina.

[1] Hill, J. M., The Yellow Pine mining district, Clark County, Nev.: U. S. Geol. Survey Bull. 540, pp. 225–226, 1913.

[2] Knopf, Adolph, A gold-platinum-palladium lode in southern Nevada: U. S. Geol. Survey Bull. 620, pp. 1–2, 1916.

In 1916 ore from mines in the Mesquite basin was being hauled by auto trucks and by teams to Roach, for rail shipment to smelters, and ore from mines near Good Springs was being brought down by the narrow-gage railroad to the main line at Jean. The prevailing high prices of copper, lead, and zinc had caused the reopening of several properties that had been idle for some time.

In the New York Mountains, south of Ivanpah, tungsten minerals (wolframite and ferberite) were discovered in May, 1916, in old copper and gold-silver prospects. When the region was visited in August, 1916, many claims had been staked and several leases had been taken, but a recent drop in the price of tungsten had caused suspension of work. The prospects are on quartz ledges that cut the coarse gray granite country rock. In some places the quartz carries small amounts of blue and green copper carbonates and black manganese oxide. The Garvanza mill, erected about 1910 2 miles southeast of Brant, for the chlorination of the gold ore, was not successfully used, but small amounts of gold and copper ores from the mines were concentrated and shipped.

About 10 or 15 years ago salt was produced in Mesquite Lake by the evaporation, in iron pans heated by mesquite wood, of brine obtained from shallow pits, and the product was taken to San Bernardino and sold. In the pits at the old workings (locality 84, Pl. VIII) crusts of salt form. A sample collected by the writer in August, 1916, was analyzed in the United States Geological Survey laboratory by W. B. Hicks and reported to be nearly pure sodium chloride. It contains small amounts of sulphate, calcium, and magnesium and a trace of potassium.

About half a mile northwest of the old salt works the surface over several acres is strewn with large crystals of gypsum, which develop in the mud and seem to work their way up to the surface, where they disintegrate and cover the ground with shining flakes. It is said that a number of years ago about 1,200 acres on the west side of the dry lake was staked as placer gypsum claims, but in 1916 no assessment work appeared ever to have been done.

GEOLOGIC SKETCH.

STRUCTURE.

The dominant structural feature of the region is the Spring Mountain, a mass of irregular shape which has a general northwesterly trend and culminates in Charleston Peak, on the east side of the Pahrump basin. The range was studied by members of the Wheeler Survey[1] and in 1900–1901 by the late R. B. Howe, whose

[1] U. S. Geol. Surveys W. 100th Mer. Rept., vol. 3, pp. 124, 166, 179, 180, 1875.

notes were incorporated by Spurr[1] in a report on the region. These studies show that the mountains have been uplifted by extensive folding and faulting. Spurr[2] says that the range "shows more complex folding than any of the ranges north or east, and to this folding the irregular shape of the range is probably due. * * * In an east-west section the general structure of the range seems to be a broad syncline, with a number of minor folds of little importance. * * * In a north-south section the structure * * * appears to be anticlinal." Hill[3] visited the south end of the range in 1912 and found that "in this region the general structure seems to be monoclinal, but it is complicated by numerous faults and some folding. * * * The ridges extending westward into Mesquite Valley are faulted in a very complicated manner."

The Kingston and Nopah ranges, which together form the western border of the Pahrump and Mesquite basins, have steep fronts, especially on the west side of the Nopah Range. According to R. B. Rowe[4] the general structure of these ranges seems to be monoclinal, the dip being eastward, but there are many faults. At Kingston Peak the rocks are somewhat folded but have a general northward dip.

No detailed studies of the mountains bordering the southern part of the Ivanpah basin have been made. Clark and Ivanpah mountains on the west, and the New York Mountains and their northern extensions in the McCullough Range, on the south and southeast, are all believed to be greatly faulted, with minor folding, and to have a complex structure, much like that of Spring Mountain, to which both the eastern and western limiting mountains of Ivanpah basin are structurally related.

CLASSES OF ROCKS.

Granite and gneiss, presumably of Archean age, are found in the southwestern part of the New York Mountains. A belt of granite forms the central part of Clark Mountain,[5] and granite also forms the core of the mass that culminates in Kingston Peak.[4] The greater part of the mountains in the region, however, are composed of ancient sedimentary rocks. Quartzite, considered to be of Cambrian age, overlies the granite of Kingston Peak, and Cambrian lime-

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[1] Spurr, J. E., Descriptive geology of Nevada south of the 40th parallel and adjacent portions of California: U. S. Geol. Survey Bull. 208, pp. 164–180, 1903.

[2] Idem, p. 175.

[3] Hill, J. M., The Yellow Pine mining district, Clark County Nev.: U. S. Geol. Survey Bull. 540, p. 233, 1914.

[4] Spurr, J. E., op. cit., p. 199.

[5] U. S. Geog. and Geol. Surveys W. 100th Mer. Rept., vol. 3, p. 32, 1875.

stones and other sedimentary rocks have been mapped by Spurr[1] as constituting the Nopah and adjacent ranges, the ranges near Clark Mountain, the McCullough Range, and the northern part of the New York Mountains. Spring Mountain and its offshoot, the Bird Spring Range, are composed chiefly of massive limestones and conglomerates of Carboniferous age.[2] Small areas of sandstone and shale of Triassic and Jurassic age are present north of Good Springs. No consolidated sedimentary materials of later age than the Jurassic have been recognized in the region, but there are a few small areas of lava, probably of Tertiary age, notably on Table Mountain, between Platina and Jean.

Each of the three valleys is underlain by deep deposits of alluvium. Great alluvial slopes extend from the bases of the mountains down to the lowlands. In their upper portions these slopes consist chiefly of angular gravel and cobbles, but in their lower portions the material is chiefly sand, silt, and clay. The greater part of the lowland in Pahrump Valley is underlain by calcareous sandy soil. In the northern part of Mesquite Valley numerous wells that were dug a few years ago show that the material is almost entirely silt and clay down to the ground-water level. In most of these wells only light-colored, nearly white calcareous clay and silt are exposed; but the northernmost well (No. 52, Pl. VIII) exposes about 50 feet of red-brown calcareous sandy silt, overlying the more common white material.

Along the east side of Pahrump Valley, from Pahrump to a point some distance south of Stump Spring, there are beds of light brown to cream-colored clay from only 2 or 3 feet thick to a maximum thickness, near Stump Spring, of about 50 feet. (See fig. 4.) The clay beds along the north side of the road between Manse and Pahrump contain layers and lenses of limestone gravel and in some places the clay is calcareous and cemented into a very hard material. A test well on the north side of the road halfway between Manse and Pahrump is said to have reached gravel underlying the clay at a depth of 41 feet. The western front of the beds form low but conspicuous bluffs at several places, notably at J. B. Yount's ranch (see Pl. X, *C*), suggesting a fault scarp. At no place were any of the clay beds observed to pass beneath the gravelly alluvium. Where the upper border was seen, east of Stump Spring and also east of Pahrump, the clay immediately overlies the alluvial wash, and its eastern limit is marked by a declivity several feet high. In the vicinity of Yount's ranch, where the formation covers the widest area, its surface rises with a uniform slope of about 100 feet to the mile north-

[1] Spurr, J. E., op. cit., pl. 1.

[2] Hill, J. M., The Yellow Pine mining district, Clark County, Nev.: U. S. Geol. Survey Bull. 540, pl. 4, 1914.

eastward to the lower border of the gravelly alluvial wash. In the southeast the clay extends up to an elevation of about 3,000 feet above sea level; but at its northwest end, near Pahrump, it is only 2,700 feet above sea level. These clay beds were presumably laid down in a lake or playa that formerly occupied that part of Pahrump Valley and were later elevated, probably with tilting and faulting.

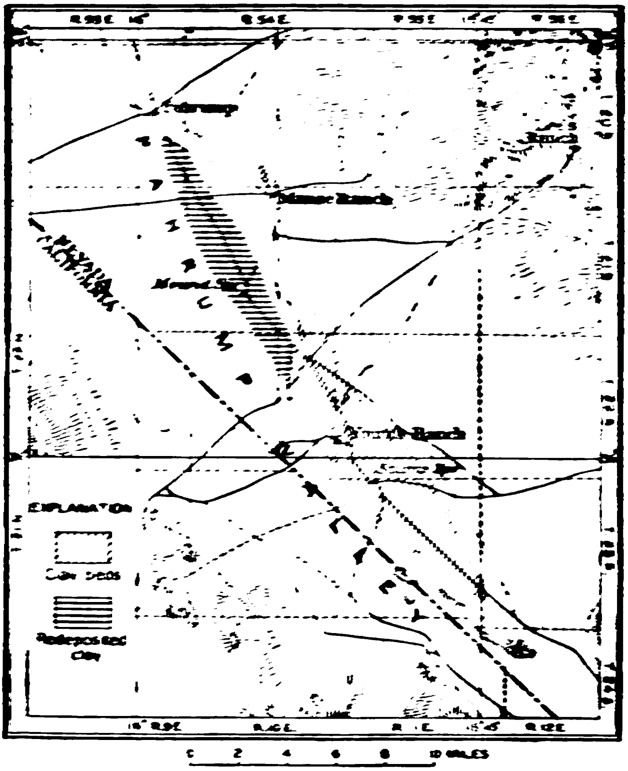

FIGURE 4.—Sketch map showing approximate extent of elevated clay beds in Pahrump Valley, Nev.

Between Mound Spring and Pahrump there is a belt of soft, fine-grained calcareous soil, standing 3 or 4 feet above the mean level of the valley floor, which seems to consist of clay redeposited by storm waters that have brought it from the main bed of clay to the east.

No evidence of clay beds appreciably above the levels of the playas and adjacent low slopes was observed in Mesquite and Ivanpah valleys. The drainage basins of these two valleys are smaller than that of Pahrump Valley, and they are surrounded in general by lower mountains, upon which less rain and snow fall, so that it is improbable that they formerly contained extensive lakes.

GROUND WATER.

PAHRUMP VALLEY.

SPRINGS.

Several large springs and many small ones are found in the mountains on the east side of Pahrump Valley and along the base of the mountains. A few large springs also occur farther down in the valley.

Lee's Spring and Trout Spring, up in the mountains, and Intermittent Spring and the Pahrump Valley springs, at the base of the mountains, yield large flows. The records of flow of these streams, as measured by the United States Geological Survey, are given in the following tables:

Daily discharge, in second-feet,[a] of Lee's Spring near its source, 18 miles east of Pahrump, Nev., for the period Apr. 1 to Sept. 30, 1916.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May	June.	July.	Aug.	Sept.
1	9.0	12	4.9	2.4	1.5	0.9	16	10	7.1	3.8	3.7	1.2	0.7
2	8.9	11	4.7	2.4	1.7	.9	17	12	6.6	3.7	2.9	1.1	.7
3	9.7	12	4.7	2.3	1.6	.9	18	12	6.2	3.5	2.6	1.1	.6
4	8.0	14	4.7	2.3	1.5	.9	19	12	6.4	3.5	2.3	1.0	.6
5	7.3	15	4.5	2.2	1.5	.9	20	12	6.0	3.2	2.0	1.0	.6
6	6.8	13	4.5	2.2	1.4	.8	21	13	6.0	3.0	1.9	1.0	.6
7	6.8	12	4.5	1.7	1.4	.8	22	14	6.2	2.7	1.9	1.0	.6
8	8.0	12	4.4	1.6	1.4	.8	23	16	6.2	2.7	1.9	1.0	.6
9	9.9	11	4.4	1.6	1.4	.8	24	18	5.8	2.8	1.7	1.0	.6
10	12	10	4.4	1.6	1.3	.8	25	18	5.5	2.8	1.6	1.0	.6
11	11	9.6	4.4	1.6	1.3	.7	26	20	5.1	2.7	1.6	1.0	.5
12	8.9	9.2	4.2	1.6	1.3	.7	27	20	5.3	2.6	1.6	1.0	.5
13	7.8	8.4	4.0	1.6	1.3	.7	28	20	5.3	2.4	1.5	1.0	.5
14	7.3	8.0	4.0	2.0	1.2	.7	29	19	5.3	2.4	1.5	.9	.5
15	8.4	7.5	4.0	12	1.2	.7	30	16	5.3	2.4	1.5	.9	.5
							31	......	5.1	......	1.5	.9	......

[a] A second-foot is equal to about 448 gallons per minute.

Monthly discharge of Lee's Spring near its source, 18 miles east of Pahrump, Nev., for the period Apr. 1 to Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April	20	6.8	12.0	714
May	15	5.1	8.32	512
June	4.9	2.4	3.68	219
July	12	1.5	2.28	140
August	1.7	.9	1.20	74
September	.9	.5	.69	41
The period				1,700

eastward t
southeast
sea level:
feet abov
a lake or
and wer

Spring issues in full volume in a bouldery wash. As ıe discharge record, although the flow is large in the , it lessens until the stream becomes nearly dry in the the summer. Pahrump Valley creek heads in a large 7), and another spring, which had a flow of about 0.6 n August, 1916, joins the creek a few hundred yards be- large springs, as well as the smaller ones, derive their ly from the precipitation on the slopes above them, and their flow decreases from a maximum in the spring ain and of melting snow to a minimum at the end of the

ıtem Spring (No. 2, Pl. VIII), near the north edge of the been estimated to yield 200 barrels a day. Its water has l down to the mining camp of Johnnie for domestic use.

Spring (No. 49) is in a gully in the clay beds along the east ıe valley and apparently derives its water by seepage from ls or from the gravel immediately underlying them. Its low has been estimated at 20 barrels a day.

springs are found at the Pahrump and Manse ranches, and er at each place has been used for many years for irrigation. ıse there are two springs 75 yards apart. The temperature of ter in each is 75° F. The flow of the smaller spring is about ond-foot and the combined flow of the two springs, measured nber 30, 1916, by Albert Quill, of the United States Geological ey, was 3.23 second-feet.

the Pahrump ranch there is a group of two large springs and smaller one that are similar to those at Manse. The water rises cipally in a pool 20 or 30 feet in diameter and 3 or 4 feet deep lered by banks of partly cemented gravel a few feet high. The dy bottom of the pool is kept in ebullition by the rising water, ich has a temperature of 76½° F. The flow of the two larger rings, as measured by Albert Quill September 30, 1916, was 2.53 d 2.20 second-feet.

On J. M. Raycraft's ranch, half a mile northwest of Pahrump, ıere is a spring (near well location No. 12), which is probably simi- ar in character to the large ones at Pahrump and Manse. It rises n a small marshy area and flows about 10 gallons a minute. A few hundred yards southeast of this spring there is a mass of calcareous tufa, apparently a spring deposit, forming a low mound 10 or 15 yards in diameter.

Mound Spring, 4 miles south of Manse, formerly had a small flow. It is at the base of a low mound composed of clay and fine sand. This mound was probably built, like many similar ones at desert springs, by the moistening and retention of material blown by the

Discharge measurements of Trout Creek about 5 miles below Trout Spring, or 16 miles east of Pahrump, Nev.

[Made by Albert Quill.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1916.	*Feet.*	*Sec.-ft.*	1916.	*Feet.*	*Sec.-ft.*	1916.	*Feet.*	*Sec.-ft.*
Apr. 6	0.60	1.75	June 15	0.40	1.70	Aug. 17	0.32	1.22
20	.65	2.16	22	.40	1.70	24	.32	1.22
27	.70	2.69	30	.35	1.39	31	.33	1.25
May 8	.44	1.96	July 6	.34	1.33	Sept. 7	.31	1.16
11	.45	2.03	13	.34	1.33	14	.29	1.05
17	.45	2.03	20	.33	1.28	21	.28	1.00
24	.43	1.90	27	.33	1.28	28	.27	.94
June 1	.43	1.90	Aug. 3	.33	1.28	Oct. 5	.28	1.00
8	.42	1.83	10	.33	1.28			

Daily discharge, in second-feet, of Intermittent Spring 50 yards below its head, 16 miles east of Pahrump, Nev., for the period Apr. 1 to Sept. 30, 1916.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	23	35	16	9.4	5.0	2.2	16	20	24	17	13	4.0	1.2
2	22	33	16	9.1	5.7	2.2	17	23	23	16	10	3.7	1.1
3	22	32	16	8.6	5.7	2.0	18	24	22	16	9.1	3.5	1.1
4	21	33	16	8.1	5.2	2.0	19	24	22	15	8.3	3.3	1.0
5	20	34	16	7.8	5.0	1.9	20	24	21	14	7.8	3.1	.9
6	18	35	17	7.8	5.0	1.8	21	25	20	14	7.6	3.0	.8
7	18	34	17	7.3	4.8	1.6	22	26	19	13	7.3	3.0	.8
8	18	33	18	7.1	4.8	1.5	23	28	19	12	6.6	3.0	.8
9	19	33	18	6.8	4.8	1.5	24	31	19	12	6.4	2.8	.6
10	22	33	18	6.4	4.6	1.4	25	32	18	12	6.4	2.6	.6
11	24	33	18	6.4	4.6	1.4	26	33	17	11	6.2	2.4	6
12	22	33	18	6.2	4.4	1.3	27	36	16	11	5.9	2.5	.5
13	21	31	17	5.9	4.2	1.3	28	38	16	10	5.7	2.6	.5
14	20	29	17	5.9	4.2	1.3	29	39	16	9.9	5.2	2.5	.4
15	20	26	17	15	4.0	1.3	30	38	16	9.6	5.0	2.4	.4
							31	......	16	......	5.0	2.2	......

Monthly discharge of Intermittent Spring 50 yards below its head, 16 miles east of Pahrump, Nev., for the period Apr. 1 to Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April	39	18	25.0	1,490
May	36	16	25.5	1,570
June	18	9.6	14.9	887
July	15	5.0	7.53	463
August	5.7	2.2	3.83	236
September	2.2	.4	1.20	71
The period				4,720

Measurements of Pahrump Valley Creek (fed by the Pahrump Valley Springs) 15 miles southeast of Pahrump, Nev.

[Made by Albert Quill.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1916.	*Feet.*	*Sec.-ft.*	1916.	*Feet.*	*Sec.-ft.*	1916.	*Feet.*	*Sec.-ft.*
May 13	1.90	22.3	July 6	1.46	10.4	Aug. 24	1.14	4.53
18	1.90	22.4	13	1.40	9.19	31	1.06	3.36
24	1.86	21.6	20	1.44	9.61	Sept. 7	1.02	2.99
31	1.81	19.4	27	1.38	8.48	14	1.00	2.45
June 8	1.76	17.7	Aug. 3	1.36	8.25	21	....	1.91
15	1.71	16.6	10	1.22	5.73	28	.94	1.33
22	1.62	14.0	17	1.18	4.93	Oct. 5	....	.61
29	....	11.7						

Intermittent Spring issues in full volume in a bouldery wash. As is shown by the discharge record, although the flow is large in the spring months, it lessens until the stream becomes nearly dry in the later part of the summer. Pahrump Valley creek heads in a large spring (No. 37), and another spring, which had a flow of about 0.6 second-foot in August, 1916, joins the creek a few hundred yards below. These large springs, as well as the smaller ones, derive their water directly from the precipitation on the slopes above them, and consequently their flow decreases from a maximum in the spring months of rain and of melting snow to a minimum at the end of the dry season.

Horseshutem Spring (No. 2, Pl. VIII), near the north edge of the basin, has been estimated to yield 200 barrels a day. Its water has been piped down to the mining camp of Johnnie for domestic use.

Stump Spring (No. 49) is in a gully in the clay beds along the east side of the valley and apparently derives its water by seepage from these beds or from the gravel immediately underlying them. Its normal flow has been estimated at 20 barrels a day.

Large springs are found at the Pahrump and Manse ranches, and the water at each place has been used for many years for irrigation. At Manse there are two springs 75 yards apart. The temperature of the water in each is 75° F. The flow of the smaller spring is about 0.8 second-foot and the combined flow of the two springs, measured September 30, 1916, by Albert Quill, of the United States Geological Survey, was 3.23 second-feet.

At the Pahrump ranch there is a group of two large springs and one smaller one that are similar to those at Manse. The water rises principally in a pool 20 or 30 feet in diameter and 3 or 4 feet deep bordered by banks of partly cemented gravel a few feet high. The sandy bottom of the pool is kept in ebullition by the rising water, which has a temperature of 76½° F. The flow of the two larger springs, as measured by Albert Quill September 30, 1916, was 2.53 and 2.20 second-feet.

On J. M. Raycraft's ranch, half a mile northwest of Pahrump, there is a spring (near well location No. 12), which is probably similar in character to the large ones at Pahrump and Manse. It rises in a small marshy area and flows about 10 gallons a minute. A few hundred yards southeast of this spring there is a mass of calcareous tufa, apparently a spring deposit, forming a low mound 10 or 15 yards in diameter.

Mound Spring, 4 miles south of Manse, formerly had a small flow. It is at the base of a low mound composed of clay and fine sand. This mound was probably built, like many similar ones at desert springs, by the moistening and retention of material blown by the wind to the spring. The small spring at Mr. Raycraft's ranch i at the base of a similar mound, and it is reported that there are small springs at other mounds near by.

The springs along the border of the lowland seem to be sup by water which rises from a considerable depth under artesian produced in the extensive alluvial deposits to the east or pos from deeper sources. The general character of the alluvial slop the positions of the Manse and Pahrump ranches with respe them are shown in Plate IX, *A*, a view looking northward alon east side of the valley. Evidence that the water comes from a source is furnished by the temperature of the springs—75° Manse and $76\frac{1}{2}$° F. at Pahrump, as compared with that of Inte tent Spring—57° F. The uniform flow of the Pahrump and M springs, contrasted with the varying flow of Intermittent Spring the other mountain springs, also indicates that the mountain sp and the valley springs are supplied in different ways.

ARTESIAN WATER.

Besides the springs in Pahrump Valley that seem to give evid of artesian conditions, there are several wells that yield arte flows. (See table below.) Three wells on the Pahrump ranch h been drilled 200 or 300 yards apart, and the easternmost is 225 ya west of the main spring at this ranch. The records of these wells, p sented through the courtesy of Mr. T. G. Darrough, manager of ranch, are shown graphically in the left-hand portion of Plate The artesian flows seem to have been obtained at several horiz below a depth of 200 feet, from layers of sand or gravel beneath re tively impervious beds of clay or cement gravel. The wells have t following flows, according to measurements with current meter ma September 30, 1916, by Albert Quill, of the United States Geologic Survey:

Flows of artesian wells on Pahrump ranch.

Well No.	Flow.		Temperature (°F.).
	Second-feet.	Gallons per minute.	
1	1.25	560	$78\frac{1}{2}$
2	.64	287	75
3	.62	278	74

J. M. Raycraft has three flowing wells, each 10 inches in diameter and about 175 feet deep, at his home (locality No. 12, Pl. VIII) on a low mound of wind-blown sand half a mile northwest of Pahrump. The wells flow about 35, 35, and 260 gallons a minute

(according to measurements by the writer), and the water from each well has a temperature of 79° F. A quarter of a mile to the southeast a fourth well (No. 13) encountered flowing water at a depth of 285 feet; the discharge as measured by the writer was about 65 gallons a minute and the temperature 79° F. The following partial record of materials encountered in drilling this well was kindly furnished by Mr. Raycraft:

Record of J. M. Raycraft well (No. 13), Pahrump, Nev.

	Thickness.	Depth.
	Feet.	*Feet.*
Unrecorded	82	82
Hard limestone	3	85
Clay	5	90
Coarse cement gravel	3	93
Clay	43	136
Cement gravel	3	139
Unrecorded	147	286
Hard blue limestone (bedrock)	36	322

A fifth flowing well (No. 16), belonging to Mr. Raycraft, is said to have a somewhat larger flow than well No. 13.

F. A. Buol has also obtained flows near his house (at well locality No. 11) in five wells reported to be 150 to 520 feet deep, but detailed information concerning these wells was not obtained.

In the vicinity of Mound Spring several test wells were drilled during 1914–1916 by the Oasis Land Co. Water under artesian pressure was encountered in all of them, and in two (Nos. 32 and 33) small flows were obtained. Well No. 32 was sunk to a depth of 135 feet a few yards from Mound Spring, and in August, 1916, the water rose 15 feet above the surface. In well No. 33 flows were struck at depths of about 200 and 390 feet but were lost in gravel at 535 feet. After the well was filled to about 475 feet below the surface a slight flow was again developed. In August, 1916, the flow was about 1 gallon a minute, with a temperature of 72° F. It is said that in the Spanker wells (Nos. 40 and 41), 3 miles southwest of Mound Spring, water from the lower strata did not rise higher than 65 feet below the surface, and that the first water, struck at 23 feet, flowed down the well to the 65-foot level. J. B. Yount has sunk a well (No. 44) on his ranch, 7 miles southeast of Mound Spring, to a depth of 320 feet. A flow was not obtained, but at 225 feet water was struck in fine sand beneath clay under pressure that caused it to rise within 6 feet of the surface.

The great alluvial slopes that extend east and southeast of Yount's ranch probably contain water under considerable artesian head, and the lower portions of these slopes offer favorable conditions for obtaining artesian flow. It is possible that flows can also be developed in the lower part of Pahrump Valley, but the fact that the artesian springs and the artesian wells drilled up to August, 1916, are all more than [illegible] feet above sea level suggests that the artesian water may be shut off from the strata beneath the lower lands by the fine and relatively impervious sediments deposited in the lowest part of the valley.

WATER TABLE.

In Stewart Valley, which forms the lowest part of the Pahrump drainage basin, water is present at less than 10 feet beneath the surface and has caused the growth of salt grass. The water table around its borders fluctuates somewhat with the season and is highest in the spring, when the valley receives some surface water. The seasonal change is sufficient so that shallow wells at localities 8 and 9 (Pl. VIII), which have at times served as watering places, were dry in August, 1916. At the south end of the valley, in well No. 25, dug close to the drainage channel leading to the central depression, the water stood [illegible] feet below the surface. Farther up the same drainage course water stood about 6 feet below the surface at Sixmile Spring in a pit in a low sandy mound. In the flowing wells drilled at and near Pahrump water was struck at [illegible] to 30 feet below the surface. In well No. [illegible], about 4 miles south of Pahrump, water was struck at [illegible] feet, and in wells Nos. [illegible], 40, and 41, 4 to 6 miles farther south, at [illegible] feet. In several wells near Mound Spring water was struck at [illegible] to [illegible] feet. The water, therefore, seems to be within 40 feet of the surface throughout a large part of Pahrump Valley. The quantity of ground water recoverable from shallow wells appears to be rather small, however, as the water is obtained in fine sand and silt that do not readily furnish a pumping supply.

A well dug about 5 miles southeast of Mound Spring is said to have struck water at a depth of 97 feet. No other information concerning the depth to water beneath the higher slopes was obtained. The reported depth in this single well, however, indicates that on the east side of the valley the water table slopes upward at a gradient that makes the increase in depth to water about 25 feet with each 100 feet of rise in the elevation of the surface.

The data obtained in regard to wells in this valley are tabulated on pages 76–79.

QUALITY OF WATER.

Samples of water for analysis were collected in the Pahrump basin from two springs (Nos. 22, 29, Pl. VIII), one flowing well (No. 15, 254-foot well on Pahrump ranch), and two shallow wells (Nos. 25, 45). (See table, p. 80.) The waters are on the whole better than those from the Mesquite or Ivanpah basins, the highest total solids being only 387 parts per million. The waters from the two springs are the best. Although the conditions governing the occurrence of these two springs are apparently different, the waters are of approximately the same mineralization, differing in total solids by only 17 parts per million, and both are of the same character. No. 22 contains only 4.3 parts per million of sodium and potassium, and No. 29 contains only a trace of these elements. The samples from wells Nos. 15 and 45 are similar to the spring waters in that they are calcium-carbonate in character, but they contain somewhat more mineral matter. The most highly mineralized water analyzed from the Pahrump basin (from the Buchanan well, No. 25) contains 537 parts per million of total solids and is of the sodium-carbonate type. The greater mineralization and high sodium content of this water are probably due to the location of the well, which is in almost the lowest part of the basin, close to a channel that carries the drainage from a playa south of Sixmile Spring into the lowest part of Stewart Valley.

All the waters are of fair quality for domestic use. They can be used without difficulty for cooking and drinking but are somewhat unsatisfactory for washing on account of their rather high hardness. All the waters except that from the Buchanan well (No. 25) are classed as fair for boiler use, although the scale-forming constituents are in excess of the amounts ordinarily considered to be allowable in a fair water, according to the rating in the table on page 80. Such a classification was made because the amounts of foaming constituents are so far within the limits for a good water. The waters could be improved by proper chemical treatment for the reduction of the scale-forming constituents. The water from the Buchanan well is of poor quality for boiler use because, in addition to the large amount of scale-forming constituents, the foaming ingredients are also high. All the waters except that from the Buchanan well are good for irrigation, and even that water can be used with good results if proper care is observed. This well is used very seldom, and it is possible that the quality of the water might be improved by regular pumping.

From the analyses it seems probable that waters fair for domestic and boiler use and good for irrigation can be obtained throughout most of Pahrump Valley. In the lowest parts of the valley, especially near the playas, there may be some highly mineralized waters.

IRRIGATION.

Within recent years farming has been attempted in each of the three valleys under consideration, but success has been obtained only where irrigation is practiced. Experiments have fully demonstrated that the rainfall is too slight and uncertain and the dry periods are too long and hot to allow the successful growing of crops by dry farming.

In Pahrump Valley farming has been carried on for many years at the Manse and Pahrump ranches by irrigation from the large springs at these places. In [illegible] about [illegible] acres on the Manse ranch was under cultivation, [illegible] acres in alfalfa, [illegible] acres in vineyard and mixed orchard, and most of the remainder in grain. On the Pahrump ranch by means of the spring water and that from three flowing wells about [illegible] acres of orchard, [illegible] acres of alfalfa, and 125 acres of barley were irrigated, and in [illegible] a considerable acreage of new land was being cleared and leveled preparatory to planting to alfalfa. Northwest of the Pahrump ranch J. M. Raycraft and F. A. Buol had under cultivation lands that were irrigated by flowing wells. At Lee's ranch in Trout Canyon a few acres of alfalfa and vegetables were irrigated by the mountain stream, and at Yount's ranch a garden was supplied with water by windmills pumping from shallow wells. An attempt at farming in Stewart Valley had failed, probably because of the alkalinity of the soil as much as because of the lack of an irrigation supply. The Oasis Land Co. was preparing to develop a Carey Act project including several thousand acres in the neighborhood of Mound Spring by irrigation water from Lee's Spring and Intermittent Spring, augmented by wells. The lands in the lowest part of the valley, from the "dry lake" west of Yount's ranch to Stewart Valley, are too poorly drained and too liable to become alkaline to be suitable for farming. The lower slopes along the east side of the valley, however, are probably capable of successful cultivation at those places where ground water can be developed for irrigation either in flowing wells or in wells with low pumping lift. The ground water obtained in the valley is generally of suitable quality for agriculture except in the lowest parts, near the "dry lakes."

MESQUITE VALLEY.

SPRINGS.

The only springs reported in the Mesquite drainage basin are Keystone Spring, near the northeast border, and a spring near the Potosi mine, in the north corner of the basin. Neither was visited by the writer, but J. E. Blackburn, who mapped the region in [illegible], estimated their flow as, respectively, about 15 and 40 barrels a day. The spring near the Potosi mine has since been developed, so that in [illegible] it supplied considerable water for the mining settlement.

WATER TABLE.

The depth to water in the central part of Mesquite Valley was tested in 1910–1914 by a number of wells drilled or dug by entrymen on desert and homestead claims. The locations of the wells that were observed are shown on Plate VIII, and data as to their depth and the depth to water in them are tabulated on pages 76–79. In August, 1916, the depth to water in these wells ranged from 4 feet in pits in Mesquite Lake to 52 feet in Bullock's well, at the southeast border of the lowland; 52 feet at Sandy, in the northeast; and 67 feet in well No. 54, in the northwest. Well No. 51, drilled prior to 1910 in the northern part of the valley to furnish a water supply near the old traction road, extending from the borax deposits near Death Valley to the railroad, was dry at a total depth of 82 feet; but it is said to have formerly contained water at a depth of about 90 feet. The water table beneath the central and northern parts of the valley, along its axis, therefore seems to be fairly flat, as shown in figure 5, with a slope of only 5 or 6 feet to the mile. From northeast to southwest, across the valley, the slope of the

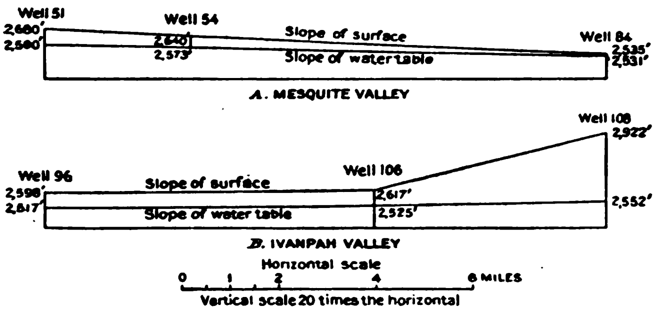

FIGURE 5.—Diagram showing slopes of surface and of water table in Mesquite and Ivanpah valleys, Calif. The Mesquite Valley section extends from northwest to southeast between wells 51 and 84 of Plate VIII; the Ivanpah Valley section extends from north-northwest to south-southeast between wells 96 and 108.

water table is somewhat greater, the available records of surface elevation and of depth to water indicating a rise of the water table toward the northwest of 10 or 12 feet to the mile.

QUALITY OF WATER.

Samples of water from six wells in Mesquite Valley (Nos. 58, 64, 72, 74, 76, and 86, Pl. VIII) were analyzed. (See table opposite p. 80.) All these waters are or have been used for domestic supply, although three of them contain more than 600 parts per million of solids in solution and have a distinctly mineralized taste. Only two of the six waters are better than the most highly mineralized water in the Pahrump basin. The character of the water apparently varies much more from place to place in Mesquite Valley than in Pahrump Valley.

The water from well No. 58, which is the least mineralized of those sampled in Mesquite Valley, is magnesium-carbonate in character. The waters from the Cryor well (No. 76) and the old Sandy

Mill well (No. 74) are like that from No. 58, in that they are carbonate waters, but in them calcium predominates over the magnesium. The Sandy Mill water, however, is more highly mineralized than the other two. These three waters are all classed as good for irrigation. They are so hard that they may be unsatisfactory for cooking and washing, but for drinking and other ordinary household purposes they are probably quite satisfactory. The waters from wells Nos. 58 and 76 are classed as only fair for boiler use because of the amount of scale-forming constituents present, and No. 74 is classed as poor because of its higher content of scale-forming constituents.

The water from the W. A. Tritt well (No. 64) is magnesium-sulphate in character. It is poor for domestic use because of its excessive hardness and bad for boiler use because of its tendency to corrode boilers—a condition, however, which could be corrected by the addition of the calculated amount of lime water. It is satisfactory for irrigation, although it contains more sodium than the waters previously described.

At locality No. 72 there were in 1916 two shallow dug wells a few yards apart, each of which was surmounted by a windmill that pumped to a cattle trough. One of these wells or a similar one was formerly known as Cub Lee Spring. The analysis shows that the water is sodium-carbonate in character. It is classed as fair for domestic use and irrigation but is bad for boiler use because of the large amount of scale-forming and foaming constituents. This water contains a greater amount of chloride than any of the waters described above. The water is probably contaminated to some extent by seepage from the mud trampled by cattle around the troughs, and the chloride content may for this reason be higher than is normal in ground water of this vicinity. An even higher chloride content, however, is found in Bullock's well (No. 86), sometimes known as Knight's well. This well was dug a number of years ago at the base of the desert wash slopes, at the southeast edge of the lowland. It has long furnished water for mines in the mountains to the northeast and for teams and autotrucks hauling ore to the railroad at Roach. The water is distinctly salty in taste, and the analysis shows that of its total content of 1,445 parts of mineral matter, 551 parts, or more than one-third, consists of the chloride radicle. The principal basic radicle is sodium. Although the water is of poor quality it is freely used for drinking and cooking because of the lack of a better supply. It is very bad for boiler use because of the high amount of foaming constituents. It is also poor for irrigation.

The two wells which have the highest chloride content are in the south end of the valley, not far from the salt-incrusted playa known as Mesquite Lake, suggesting that the ground water has become concentrated in this part of the valley by continual evaporation. On the other hand, the least mineralized waters in the basin, according to the analyses, are at the north end and on the sides of the valley some distance from Mesquite Lake.

IRRIGATION.

In 1910 to 1914 numerous homestead and desert entries were filed on land in the northern part of Mesquite Valley, and a number of wells were drilled and pumping plants established. Attempts to irrigate on an extensive scale proved unsuccessful, however, owing largely to the poor quality of the soil. In 1916 there were only two small irrigated tracts in the valley, those of W. A. Tritt and J. B. Cryor. At the Tritt ranch (locality No. 64, Pl. VIII) water was pumped from a dug well by a windmill and used to irrigate a small garden with indifferent success. As is shown by the analysis (opposite p. 80), the water is of good quality for irrigation. Any failure to produce crops was therefore due to the nature of the soil or other causes, rather than to the water. On the Cryor ranch, at Ripley, a few acres of alfalfa and garden were supplied by windmill, and the crops made a good growth under careful irrigation. The water here also is of good quality, as shown by the analysis of well No. 76. It is probable that other areas could be successfully irrigated along the eastern sandy slopes of the valley. The greater part of the shallow-water area in Mesquite Valley, however, is probably too alkaline or too clayey to permit its successful cultivation.

IVANPAH VALLEY.

WELLS, SPRINGS, AND INFILTRATION TUNNELS.

In the mountains that border the Ivanpah Valley there are a number of small but perennial springs that furnish reliable water supplies to prospectors and others. About 20 of these springs are shown on Plate VIII, and data furnished by S. G. Lunde, topographer, of the United States Geological Survey, concerning their yields, have been inserted in the records on pages 76–79. None of these springs yield much water, and some of them have no appreciable overflow during the dry months. Mescal Spring (No. 94) is said, however, to have furnished water for a small stamp mill at the Mollusk mine.

A small spring (No. 114) in the bed of a canyon has furnished water for prospectors in its immediate vicinity, and in 1916 water was also piped from it to the home of P. S. Banfield, three-quarters of a mile east of Brant, for domestic supply.

"Cut Spring" and "White Rock Spring" (Nos. 111 and 112) are small infiltration tunnels driven into the mountain side, and the seeping water collects in pools, from which it is hauled to Cima for domestic supply. At Kessler Spring (No. 113) water has been developed by a pit excavated about 10 feet deep in a dry wash and curbed and roofed with boards. From the bottom of the pit a pipe extends down the wash for several rods, so that a gravity flow is obtained at cattle troughs and at a faucet for domestic and travelers' supplies. Water supplies have been obtained at other places in washes at high levels in shallow wells like that of Kessler Spring, but so far as was learned gravity flows have not been developed elsewhere in this region by piping. The Mexican well (No. 93) is reported to be only 5 feet deep and usually to contain about 3 feet of water. When visited by D. G. Thompson late in 1917 it was tightly covered and equipped with a force pump. Water was hauled from the well to the Mohawk mining camp, 4½ miles west of the well, and was also used in considerable quantities by teams hauling ore from this camp to Roach. The supply is apparently very good. Water has been developed by somewhat deeper wells dug in the gravelly wash at Crescent (No. 104). The mining camp of Good Springs (No. 63) received its name from springs that formerly flowed in considerable volume, but it is said that of late years water is obtained chiefly from wells about 30 feet deep, dug in the gravel wash.

At Borax siding, 4 miles south of Jean, a well (No. 87, Pl. VIII) was drilled in 1905 by the Los Angeles & Salt Lake Railroad Co. to a depth of 687 feet. The record, kindly furnished by the company and reproduced graphically in Plate XI (p. 64), shows that only relatively coarse, unconsolidated materials were encountered. Water stood in the well 199 feet below the surface in 1905. The pumping station was dismantled in 1914, as the pumping station near Ivanpah served the railroad needs.

At Roach a test well, drilled by George Morgan, struck water at 91 feet. The water is said to be of fair quality, but the settlement is supplied with water brought by train from Las Vegas, as is also the town of Jean.

An abandoned dug well (No. 89) 2½ miles southwest of Roach and the Francis well (No. 102), dug more than 20 years ago on the west side of Ivanpah Valley, near the traction road, both contained water in August, 1916, at a depth of 90 feet below the surface.

The Yates well (No. 96) and the Murphy well (No. 106) were dug a number of years ago for cattle watering places. They are situated, respectively, at the west edge of Ivanpah Lake and at the south edge of the flat land bordering the "dry lake." They were abandoned some time prior to 1916, but the Murphy well was again used in 1917 for watering cattle. In August, 1916, the Yates well contained water at 81 feet and the Murphy well at 92 feet. Several wells drilled in 1914–1916 between the Murphy and Yates wells encountered water at practically the same level as in these wells. On the extensive alluvial slope in the southern part of the Ivanpah basin a well of the Los Angeles & Salt Lake Railroad supplies water to a reservoir near Ivanpah, for locomotive use. The reported depth to water in this well—370 feet—indicates that the water table beneath the valley is unusually flat, as is illustrated in figure 5 (p. 69). The rise of the water table southward from the Murphy well to the railroad well is only 5 feet to the mile, whereas the rise in elevation of the surface is 61 feet to the mile. From east to west across the valley the water table also seems to be nearly horizontal; for at Lyon station, 2,800 feet above sea level, the depth to water is reported to be 275 feet, the elevation of the water table therefore being 2,525 feet, or only 8 feet above the elevation of the water surface in the Yates well. The flatness of the water table indicates that the desert wash is fairly coarse and permeable throughout, so that water does not collect in porous sands and gravels between layers of relatively impermeable clay. In the wells that have been drilled, it is reported, water was encountered under little or no artesian pressure.

In many of the basins of the Southwest that have no outlets for surface water the supply of ground water received from precipitation is about balanced by losses through springs and evaporation from lakes or from the soil where the water is close to the surface. This condition is present in Pahrump and Mesquite valleys, where moist lands are found respectively in Stewart Valley and in Mesquite Lake. Beneath the lowest portions of Ivanpah Valley, however, the depth to water is about 80 feet, and it seems impossible that evaporation keeps the water table down to so great a depth below the surface. The water table from east to west across the valley is shown by the depth to water in wells Nos. 96 and 97 to be nearly horizontal. Toward the south the water table (see fig. 5) slopes gently upward. The elevation above sea level of the water table in Ivanpah Valley is about 2,515 feet and in Mesquite Lake about 2,531 feet, so that there would seem to be no underground escape northward. It is possible that leakage sufficient to balance the relatively small annual ground-water intake and keep the water table down to about 80 feet below the surface takes place along fault fractures extending northeastward toward Las Vegas Valley.

QUALITY OF WATER.

Samples of water from two springs (Nos. 111 and 113, Pl. VIII) and six wells (Nos. 89, 93, 96, 103, 106, and 108) in the Ivanpah basin were analyzed. (See table opposite p. 80.) One analysis furnished by the Los Angeles & Salt Lake Railroad (well No. 97) has been included in the table. The analyses show great extremes in the degree of mineralization of the waters in the valley, one sample (No. 108), which is the best water analyzed from the three valleys described in this report, having only 240 parts per million of total dissolved solids. Another water (No. 89) contains more than 100 times as much. Four of the nine waters are of good or fair quality for domestic, boiler, and irrigation use.

The waters from three wells in the southern part of the basin (Nos. 103, 106, and 108) are relatively low in total solids. Of these the water from the railroad well (No. 108) on the alluvial slope some distance above Ivanpah Lake contains only 240 parts per million, and the waters from the other two wells, which are much nearer the clay flat, are higher in total solids, containing 372 and 335 parts. The water from the railroad well is a sodium-sulphate water and the other two are sodium-carbonate waters. All three waters are classed as good for domestic use. The water from the railroad well, which is regularly used for locomotives, is classed as good for boilers. The other two are classed as only fair for boiler use on account of their content of foaming constituents. The water from the Murphy well (No. 106) will also form considerable scale. The waters from the railroad and Murphy wells are good for irrigation, but that from well No. 103 is only fair.

According to analyses of samples from wells Nos. 89 and 96, the water farther north, in the lowest part of the valley, is much poorer; in fact, it is practically unfit for any use. These wells are dug only a few feet below the ground-water level. It is said that they furnished water of fair quality when they were used regularly. They had been abandoned for some time prior to August, 1916, and at that time contained waters that were practically brines, one (No. 96) containing 7,702 parts per million of total solids and the other (No. 89) containing the unusually high amount of 27,501 parts per million. Both waters taste salty. It is said that in digging the Yates well (No. 96) salty water was first struck, but better water was obtained a few feet deeper. It is probable that in each well the water has become concentrated on standing unused. Both waters are sodium-chloride in character, and both are unfit for domestic, boiler, or irrigation use. A water from a well drilled by the Los Angeles & Salt Lake Railroad Co. at Lyons (Desert station) (No. 97), almost due east of Yates, according to an analysis furnished by the railroad company, is of much better quality, containing only 433 parts per million of total solids. It is sodium-chloride in character. This well is some distance up the alluvial slope away from the clay flat. The water is classed as good for domestic purposes, bad for boiler use, and fair for irrigation.

The remaining sources from which samples were analyzed, Nos. 93, 111, and 113, are all in the mountainous parts of the Ivanpah basin. Each of the three waters is a carbonate water. Two of them, from Cut Spring (No. 111) and Kessler Spring (No. 113), are calcium-carbonate waters. They are both classed as only fair for domestic use because of their hardness; they will probably require a considerable amount of soap in washing, but are good for drinking and other household purposes. The water from Cut Spring is hauled to Cima for domestic use. The waters from both Cut Spring and Kessler Spring are good for irrigation.

The water from Mexican well (No. 93) is sodium-carbonate in character and is considerably higher in total solids than the other two. It is good for irrigation but poor for boiler use because of its large amount of scale-forming and foaming constituents and poor for washing because of its high hardness. This water is used considerably by travelers, and despite its hardness it can probably be used for drinking and other ordinary household uses without any bad effects.

Although analysis shows two waters from the Ivanpah basin to be very highly mineralized, it is believed that throughout the greater part of the region water of good or fair quality for both domestic purposes and irrigation is available. The two saline waters were obtained from wells in the lowest part of the basin, at the edge of the playa. The high mineralization of these waters may be due to concentrated surface waters running into the wells or to salt derived from the clay of the playa. The water from wells on the alluvial slopes, some distance from the clay flat, is generally of good quality.

IRRIGATION.

During the three years prior to 1916 several wells were drilled in the lowlands south of Ivanpah Lake and a few attempts at irrigation were made, but these attempts proved unsuccessful on account of the clayey character of the soil. On the higher land, near Cima and Brant, gardens have been grown with water from springs, but the available supply from such sources is insignificant. Farming other than the cultivation of small gardens probably can not be successfully carried on in any part of Ivanpah Valley because of the lack of available water. Irrigation by means of wells is not feasible, because of the excessive pumping lift involved, and because water is not found in great enough quantity. In January, 1918, it was stated that the Murphy well (No. 106) could be pumped dry in about four hours at a rate of about 20 gallons a minute. This amount of water was derived from a 12-foot tunnel at the bottom of the well, which is in adobe. The water does not filter in rapidly enough to meet the ordinary requirements of irrigation. The soil in the lowest part of the valley, where the pumping lift is the least, is too clayey and too alkaline for successful cultivation. There is no stream water available, and apparently no suitable locations for storage reservoirs nor sufficient flood water to be of value if it could be stored.

In the later part of 1917 and the early part of 1918 no one was attempting farming in the Ivanpah Valley, and the valley had been practically abandoned as an agricultural project. The Rock Springs Cattle Co. had improved the Murphy well (No. 106) and was using it to water about 200 head of cattle. The number of cattle that may be kept in the valley is largely limited by the available supply of wild grass, as the conditions of water supply and soil will not permit the cultivation of grazing crops.

RECORDS OF WELLS AND SPRINGS.

Most of the wells and springs listed in the following pages have been mentioned in the text. The available data concerning all those whose locations are shown on Plate VIII are here brought together in tabular form for easy reference in connection with the map.

Records of wells and springs in Pahrump, Mesquite, and Ivanpah valleys, Nev.-Calif.

[For analyses of water see table opposite p. 80.]

No. on Plate VIII.	Location.[a]			Owner of well or name of spring.	Depth of well.	Depth to water in well August, 1916.	Remarks.
	Township.	Range.	Section.				
					Feet.	*Feet.*	
1	17 S.	53 E.	23	Spring			
2	17 S.	53 E.	27	Horseshutem Spring			Good water; yields 200 barrels a day.
3	17 S.	53 E.	36	Crystal Spring			
4	18 S.	54 E.	6	Rainbow Spring			Good water; yields 45 barrels a day.
5	18 S.	55 E.	19	Wheeler well			Yields several barrels a day.
6	19 S.	54 E.	14 23	Horse Springs			Yields a few barrels a day.
7	19 S.	55 E.	3	Buck Spring			Do.
8	20 S.	52 E.	6	Formerly a spring	8	Dry.	
9	20 S.	52 E.	7	.....do	6	Dry.	
10	20 S.	52 E.	1	Sixmile Spring		6	
11	20 S.	53 E.	15	F. A. Buol	150 150 160 300 520	Flow.	Five wells reported.
12	20 S.	53 E.	15	J. M. Raycraft	170	Flow.	Three 10-inch wells; flow struck at 156 feet; flows of about 35, 35, and 260 gallons a minute. Also spring flowing about 10 gallons a minute.
13	20 S.	53 E.	14	.....do	322	Flow.	Drilled well; 30 feet to ground water; flow at 285 feet.
14	20 S.	53 E.	14	Pahrump Valley Co. (springs).			See discharge measurements (p. 63).
15	20 S.	53 E.	14	Pahrump Valley Co.	254 322 516	Flow.	Three wells. See records (fig. 5), discharge measurements (p. 64), and analysis of 254-foot well.
16	20 S.	53 E.	22	J. M. Raycraft	520	Flows.	
[illegible]	[illegible]	55 E.	2	Spring			

[illegible] with "south" township numbers refer to Mount Diablo base and meridian; "north" township numbers to San Bernardino base and meridian.

Records of wells and springs in Pahrump, Mesquite, and Ivanpah valleys, Nev.-Calif.—Continued.

No. on Plate VIII.	Location. Township.	Range.	Section.	Owner of well or name of spring.	Depth of well.	Depth to water in well August, 1916.	Remarks.
					Feet.	*Feet.*	
18	20 S.	56 E.	5	Lees Spring			Good water. See discharge measurements (p. 61).
19	20 S.	56 E.	3	Spring			
20	20 S.	56 E.	15	Trout Spring			Good water; flows 100 barrels a day. See discharge measurements (p. 62).
21	20 S.	56 E.	29	Spring			Slight flow.
22	20 S.	56 E.	31	Intermittent Spring			See discharge record (p. 62) and analysis.
23	20 S.	56 E.	31	Spring			Good water; yields 4 barrels a day.
24	20 S.	57 E.	27	.....do			Yields 50 barrels a day.
25	24 N.	8 E.	28	B. P. Buchanan	40	38	See analysis.
26	21 S.	53 E.	1	Oasis Land Co	416	32	
27	21 S.	53 E.	23	Spring			Flow about 1 quart a minute to cattle trough.
28	21 S.	53 E.	25	Oasis Land Co	210	23	
29	21 S.	54 E.	3	Hoffman & Vetter (Manse Springs).			Discharge, 2¾ second-feet. See analysis (smaller spring).
30	21 S.	54 E.	22	Spring			Has summer flow of ½ gallon a minute at 69° F.; unused.
31	21 S.	54 E.	28	Oasis Land Co	163	23	Water struck at 39 feet, rose to 23 feet; drilling in August, 1916.
32	21 S.	54 E.	28	.....do	135	Flows.	Ground water at 35 feet. At Mound Spring.
33	21 S.	54 E.	28	.....do	535	Flows.	Ground water at 28 feet; flow 1 gallon a minute at 72° F.
34	21 S.	54 E.	28	.....do	230	Nearly at surface.	Water struck at about 20 feet, rose nearly to surface.
35	21 S.	54 E.	28	.....do	165	14	
36	21 S.	56 E.	19	Spring			Is source of Pahrump Valley creek.
37	21 S.	56 E.	19	.....do			Flow in August, 1916, 0.63 second-feet.
38	21 S.	57 E.	5	Coal Spring			
39	21 S.	57 E.	7	Roses Spring			Reported flow of more than 10 miner's inches.
40	22 S.	54 E.	6	—— Spanker	165 165	23 23	Two drilled wells.
41	22 S.	54 E.	6	.....do	35	23	Test well; pumping test of 15 miner's inches for 3 hours.
42	22 S.	54 E.	14	Spring			Fair water; yields 10 barrels a day.
43	22 S.	54 E.	27	.....do			Fair water; yields 15 barrels a day.
44	22 S.	55 E.	30	J. B. Yount	320	6	Test well. All clay except quicksand at 225–230 feet, with water under pressure.
45	22 S.	55 E.	30	.....do	10–15	7–10	Three wells and windmills. See Pl. X, *C*, and analysis of easternmost well.
46	22 S.	57 E.	15	Mule Spring			Good water; yields 15 barrels a day.
47	22 S.	58 E.	20	Mountain Spring			Good water; yields 20 barrels a day.
48	21 N.	10 E.	16	Dry well			
49	23 S.	55 E.	5	Stump Spring			Fair water; yields 20 barrels a day.
50	23 S.	57 E.	1	Potosi mine spring			Good water; yields 40 barrels a day.
51	20 N.	12 E.	30	R. M. Pettis	82	Dry.	
52	20 N.	12 E.	28	R. W. Barry	67	66	Dug; 0.50 foot, red-brown calcareous clay; 50–67 feet, white clay.
53	20 N.	12 E.	33	O. S. Erickson	57	Dry.	Dug in wash; clay.
54	20 N.	12 E.	33	Mike Ryman	71+	67	Centrifugal-pump pit, 71 feet deep; drilled well in bottom.
55	20 N.	12 E.	33	O. S. Erickson	[a]1,083	56	Water struck at 135 feet, rose to 56 feet; at oil-well rig.
56	20 N.	12 E.	34	G. W. Mitchell	41	40	Dug test well.
57	20 N.	12 E.	34	.....do	37	Dry.	Do.

[a] Reported.

Records of wells and springs in Pahrump, Mesquite, and Ivanpah valleys, Nev.-Calif.—Continued.

No. on Plate VIII.	Location: Township.	Location: Range.	Location: Section.	Owner of well or name of spring.	Depth of well.	Depth to water in well August, 1916.	Remarks.
					Feet.	*Feet.*	
58	20 N.	12 E.	34	Charles Heidecke	41	38	Dug. See analysis.
59	20 N.	12 E.	34	do	37	36	Dug; test well.
60	20 N.	12 E.	15	C. M. Gay	39	38	Do.
61	24 S.	57 E.	35		500	58	Two drilled wells, 12 feet apart; good supply reported at 135 feet.
62	24 S.	58 E.	6	Keystone Spring			Good water; yields 15 barrels a day.
63	24 S.	58 E.	25	Good springs	30±		Formerly flowing springs; now shallow wells.
64	19 N.	12 E.	2	W. A. Tritt	29	27	Dug; windmill; domestic use. See analysis.
65	19 N.	12 E.	12	J. H. Pate	43	Dry.	Dug.
66	19 N.	12 E.	11	J. H. Burke	30	29	Dug; test well.
67	19 N.	12 E.	11	do	35	27	Dug; centrifugal pump.
68	19 N.	12 E.	12	C. M. Hill	18	Dry.	Dug; test well.
69	19 N.	12 E.	9		55	34	Dug.
70	19 N.	12 E.	14	C. A. Burke		28	12 inch, drilled.
71	19 N.	12 E.	13	H. A. Hoffman (Osborn well)	17	Dry.	Caved; 12-inch casing.
72	19 N.	13 E.	19	J. B. Yount	11	8	Two dug wells and windmills; cattle watering. See analysis (west well).
73	19 N.	13 E.	32	Roses well	6	Dry.	
74	25 S.	57 E.	5	Old Sandy Mill well	56	32	Dug; windmill, tank, and watering trough. See analysis.
75	25 S.	57 E.	5		50	48	Dug; small engine and pump in center of Platina.
76	25 S.	57 E.	5	J. B. Cryer	50	48	Dug; windmill. See analysis.
77	25 S.	57 E.	4	Boss mine	65	58	Dug; mine supply.
78	25 S.	57 E.	9		36	35	Dug; test well.
79	25 S.	57 E.	17		25	Dry.	Dug.
80	25 S.	57 E.	22		23	22	Dug; test well.
81	25 S.	57 E.	26		8	8	Do.
82	25 S.	57 E.	36			2	Pits dug by Indians at base of sand ridges.
83	25 S.	57 E.	36		42	Dry.	Dug.
84	18 N.	13 E.	5			4	Brine; in pits at old salt works.
85	18 N.	13 E.	8		15	12	Dug; at abandoned adobe house.
86	18 N.	13 E.	12	Bullock's well	56	53	Dug; hand pump; supply for prospectors and for Milford mine. See analysis.
87	26 S.	59 E.	2	Los Angeles & Salt Lake R. R.	687	199	At Borax siding. Abandoned, 14-inch well.
88	26 S.	59 E.	34	George Morgan	91	91	Drilled; test well; clay, to fine sand with fair water at bottom.
89	27 S.	59 E.	8	Old "Borax Team" well	92	90	Dug; unused. See analysis.
90	27 S.	61 E.	7	Railroad Spring			Fair water; yields 20 barrels a day.
91	17 N.?	13 E.?	33, 24*, 25	Springs			Slight flows; in unsurveyed township.
92	17 N.?	13 E.?	36*	do			Do.
93	16 N.	13 E.		Mexican well	5	2	In sandy wash; good supply. See analysis.
94	16 N.?	13 E.?	13*	Mezcal Spring			Yields 200 barrels a day.
95	16 N.	14 E.	31	Roseberry Spring			Yields about 10 barrels a day.
96	16 N.	15 E.	6	S. E. Yates	91	81	Dug; unused. See analysis.
97	16 N.	15 E.	12	Los Angeles & Salt Lake R. R.	506	275	See record (fig. 5) and analysis.
98	16 N.	15 E.	17	Roy White	85	77	12-inch drilled well.
99	16 N.	15 E.	21	A. Dixon	130	79	Do.
100	16 N.	15 E.	33	A. E. Weaber	130	87	Do.
101	16 N.	15 E.	33	Chris. Mattly	130 130	82½ 84	Two wells; 12-inch, drilled.
102	16 N.	15 E.	32	San Francis	92	90	Dug; good water.
103	16 N.	15 E.	33	Ruben Buchner	412	88	See record (fig. 5) and analysis.

Records of wells and springs in Pahrump, Mesquite, and Ivanpah valleys, Nev.-Calif.—Continued.

No. on Plate VIII.	Location. Township.	Range.	Section.	Owner of well or name of spring.	Depth of well.	Depth to water in well August, 1916.	Remarks.
					Feet.	*Feet.*	
104	28 S.	61 E.	8	At Crescent, wells 30+			Shallow dug wells in wash.
105	28 S.	61 E.	10	Water hole			Fair water; yields 15 barrels a day.
106	15½ N.	15 E.	3	Murphy well	116	92	Dug; walled with 3-foot tile casing with 12-foot crosscut at bottom; cement lined. Can be pumped dry in 4 hours at rate of 20 gallons a minute. On Oct. 26, 1917, the depth to water was 100 feet. See analysis.
107	15 N.	14 E.	2	Mineral Spring			Fair water.
108	15 N.	15 E.	13	Los Angeles & Salt Lake R. R.	530	370	See record (fig. 5) and analysis.
109	15 N.	16 E.	36	Willow Spring			Good water; yields 50 barrels a day.
110	15 N.	17 E.	19	Dove Spring			Do.
111	14 N.	13 E.	23	Cut Spring			Yields 50 barrels a day. See analysis.
112	14 N.	13 E.	25	White Rock Spring			Yields 40 barrels a day.
113	14 N.	14 E.	18	Kessler Spring			Yields 100 barrels a day See analysis.
114	14 N.	15 E.	23	Spring			
115	14 N.	15 E.	28	Cottonwood Spring			
116	14 N.	15 E.	27	Spring			
117	14 N.	16 E.	9	Slaughterhouse Spring			Good water; yields 75 barrels a day.
118	14 N.	16 E.	16	Mexican Spring			
119	16 N?	16 E.	33?	Wheaton Spring			Water piped from tunnel in granite 100 yards to galvanized-iron trough; flows about 100 barrels a day.
120	13 N.	14 E.	5	At Cima	135	Dry.	Dug; test well. No water struck.
121	13 N.	15 E.	8	Spring			
122	13 N.	15 E.	18	do			

QUALITY OF WATER.

CLASSIFICATION.

Samples of water from 12 wells and 3 springs in the three basins under consideration were collected by the writer and analyzed under contract by S. C. Dinsmore, Reno, Nev. Four additional samples, three from wells and one from a spring, were collected by David G. Thompson in the fall of 1917 and were analyzed in the laboratory of the water-resources branch of the United States Geological Survey. One analysis of water from a well owned by the Los Angeles & Salt Lake Railroad Co. was furnished by that company. The results of the analyses, together with a classification of the waters for domestic, boiler, and irrigation use, are given in the table opposite page 80.

The classification[1] of waters for domestic use, as given in the table, is based on the determinations of the dissolved mineral constituents and their chemical character. The suitability of a water for domestic use depends on its acceptability for drinking, washing,

[1] Mendenhall, W. C., Dole, R. B., and Stabler, Herman, Ground water in San Joaquin Valley, Calif.: U. S. Geol. Survey Water-Supply Paper 398, pp. 73–82, 1916.

and cooking, as determined chiefly by the amounts of iron, nitrate, and chloride in solution and by the hardness of the water. Waters high in hardening constituents can be used for drinking, but they are unsatisfactory for cooking and laundering. Hardness exceeding 1,500 parts per million makes water unfit for cooking. The hardness sufficient to cause prohibitive soap consumption in washing is much less than that which makes water undesirable for cooking.

The presence of approximately 200 parts per million of carbonate, 250 parts of chloride, or 300 parts of sulphate may give the water a slight taste. Waters containing considerably more of these constituents can be tolerated by human beings, but those which contain more than 300 parts per million of carbonate, 1,500 parts of chloride, or 2,000 parts of sulphate are intolerable to most people. Local conditions and individual preference, however, largely determine the significance of the terms "good" or "bad," as applied to the mineral quality of water for domestic use. For instance, in a desert region a water containing 240 parts per million of hardness might be classed as fair; in a region where the supply is abundant and the quality is in general much better, as in the New England States, the same water would be classed as bad by most users. It should be borne in mind in this report that the classification of a water for domestic use is based only on its mineral content, and although certain determinations afford indications of the sanitary quality of the water they may not permit a complete sanitary interpretation. A water may contain only small amounts of dissolved solids and yet be so badly polluted as to be unsafe for drinking.

With respect to their quality for use in boilers, waters are first classified according to their scale-forming and foaming constituents and the probability of corrosion, and from these data the advisability of their use is determined. Scale is formed in boilers by certain substances that go out of solution on heating and concentration of the water. Foaming, or the formation of masses of bubbles in the boiler, is caused by certain salts or by fine mud or other matter in the water. The corrosion or pitting of the walls and tubes of boilers is caused by electrolytic action, which may be accelerated or retarded by the presence of various substances in solution.

Rating of waters for boiler use according to proportions of incrusting and corroding constituents and according to foaming constituents.

Incrusting and corroding (scale-forming) constituents.		Foaming constituents.	
Parts per million.	Classification.[a]	Parts per million.	Classification.[b]
Not more than 90	Good	Not more than 150	Good.
91 to 200	Fair	151 to 250	Fair.
201 to 430	Poor	251 to 400	Bad.
More than 430	Bad	More than 400	Very bad.

[a] Am. Ry. Eng. and Maintenance of Way Assoc. Proc., vol. 5, p. 595, 1904.
[b] Idem, vol. 9, p. 134, 1908.

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No. on Plate VIII.[a]	Date of collection.	Silica (SiO_2).	Classification.[b] Chemical character.	Probability of corrosion.[d]	Quality for boiler use.	Quality fc domestic use.	Quality for irrigation.
	1916.						
15	Aug. 29	8.0	Ca-CO_3...	(?)	Fair.........	Fair.......	Good.
22	Aug. 24	10	...do.......	(?)	.....do.......	...do.......	Do.
25	Aug. 26	36	Na-CO_3...	N	Poor.........	...do.......	Fair.
29	Aug. 27	18	Ca-CO_3...	(?)	Fair.........	...do.......	Good.
45	...do.....	13	...do.......	(?)	.....do.......	...do.......	Do.

No. on Plate VIII.[a]	Date of collection.	Silica (SiO_2).	Chemical character.	Probability of corrosion.[d]	Quality for boiler use.	Quality for domestic use.	Quality for irrigation.
	1916.						
58	Aug. 26	23	Mg-CO_3...	(?)	Fair.........	Poor......	Good.
64	Aug. 27	26	Mg-SO_4...	C	Bad.........	...do.......	Do.
72	Aug. 25	53	Na-CO_3...	(?)	.....do.......	Fair.......	Fair.
	1917.						
74c	Oct. 28	24	Ca-CO_3...	(?)	Poor........	Poor......	Good.
	1916.						
76	Aug. 27	18	.....do.....	(?)	Fair.........	...do.......	Do.
86	Aug. 25	35	Na-Cl.....	(?)	Very bad....	...do.......	Poor.

No. on Plate VIII.[a]	Date of collection.	Silica (SiO_2).	Chemical character.	Probability of corrosion.[d]	Quality for boiler use.	Quality for domestic use.	Quality for irrigation.
	1916.						
89	Aug. 25	23	Na-Cl.....	C	Unfit........	Unfit......	Bad.
	1917.						
93c	Oct. 27	45	Na-CO_3...	(?)	Poor........	Poor......	Good.
	1916.						
96	Aug. 24	30	Na-Cl.....	C	Unfit........	Unfit......	Bad.
	1915.						
97g	Oct. 28	[h]17	...do.......	(?)	Bad.........	Good......	Fair.
	1916.						
103	Aug. 24	41	Na-CO_3...	N	Fair.........	...do.......	Do.
	1917.						
106c	Oct. 26	59	...do.......	N	.....do.......	...do.......	Good.
	1916.						
108	Aug. 24	17	Na-SO_4...	(?)	Good.........	...do.......	Do.
	1917.						
111k	Nov. 6	45	Ca-CO_3...	(?)	Poor........	Fair.......	Do.
	1916.						
113	Aug. 23	36	...do.......	(?)	Fair.........	...do.......	Do.

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and cooking, as determined chiefly by the amounts of iron, nitrate, and chloride in solution and by the hardness of the water. Waters high in hardening constituents can be used for drinking, but they are unsatisfactory for cooking and laundering. Hardness exceeding 1,500 parts per million makes water unfit for cooking. The hardness sufficient to cause prohibitive soap consumption in washing is much less than that which makes water undesirable for cooking.

The presence of approximately 200 parts per million of carbonate, 250 parts of chloride, or 300 parts of sulphate may give the water a slight taste. Waters containing considerably more of these constituents can be tolerated by human beings, but those which contain more than 300 parts per million of carbonate, 1,500 parts of chloride, or 2,000 parts of sulphate are intolerable to most people. Local conditions and individual preference, however, largely determine the significance of the terms "good" or "bad," as applied to the mineral quality of water for domestic use. For instance, in a desert region a water containing 240 parts per million of hardness might be classed as fair; in a region where the supply is abundant and the quality is in general much better, as in the New England States, the same water would be classed as bad by most users. It should be borne in mind in this report that the classification of a water for domestic use is based only on its mineral content, and although certain determinations afford indications of the sanitary quality of the water they may not permit a complete sanitary interpretation. A water may contain only small amounts of dissolved solids and yet be so badly polluted as to be unsafe for drinking.

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Incrusting and corroding (scale-forming) constituents.		Foaming constituents.	
Parts per million.	Classification.[a]	Parts per million.	Classification.[b]
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201 to 430	Poor	251 to 400	Bad.
More than 430	Bad	More than 400	Very bad.

[a] Am. Ry. Eng. and Maintenance of Way Assoc. Proc., vol. 5, p. 595, 1904.
[b] Idem, vol. 9, p. 134, 1908.

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No. on Plate VIII.[a]	Date of collection.	Silica (SiO_2).		Classification.[b] Chemical character.	Probability of corrosion.[d]	Quality for boiler use.	Quality fc domestic use.	Quality for irrigation.
	1916.							
15	Aug. 29	8.0		$Ca-CO_3$	(?)	Fair	Fair	Good.
22	Aug. 24	10		...do...	(?)	...do...	...do...	Do.
25	Aug. 26	36		$Na-CO_3$	N	Poor	...do...	Fair.
29	Aug. 27	18		$Ca-CO_3$	(?)	Fair	...do...	Good.
45	...do...	13		...do...	(?)	...do...	...do...	Do.
	1916.							
58	Aug. 26	23		$Mg-CO_3$	(?)	Fair	Poor	Good.
64	Aug. 27	26		$Mg-SO_4$	C	Bad	...do...	Do.
72	Aug. 25	53		$Na-CO_3$	(?)	...do...	Fair	Fair.
	1917.							
74c	Oct. 28	24		$Ca-CO_3$	(?)	Poor	Poor	Good.
	1916.							
76	Aug. 27	18		...do...	(?)	Fair	...do...	Do.
86	Aug. 25	35		$Na-Cl$	(?)	Very bad	...do...	Poor.
	1916.							
89	Aug. 25	23		$Na-Cl$	C	Unfit	Unfit	Bad.
	1917.							
93c	Oct. 27	45		$Na-CO_3$	(?)	Poor	Poor	Good.
	1916.							
96	Aug. 24	30		$Na-Cl$	C	Unfit	Unfit	Bad.
	1915.							
97g	Oct. 28	h 17		...do...	(?)	Bad	Good	Fair.
	1916.							
103	Aug. 24	41		$Na-CO_3$	N	Fair	...do...	Do.
	1917.							
106c	Oct. 26	59		...do...	N	...do...	...do...	Good.
	1916.							
108	Aug. 24	17		$Na-SO_4$	(?)	Good	...do...	Do.
	1917.							
111k	Nov. 6	45		$Ca-CO_3$	(?)	Poor	Fair	Do.
	1916.							
113	Aug. 23	36		...do...	(?)	Fair	...do...	Do.

arborn Chemical Co.

146587—(To face page

and cooking, as determined chiefly by the a
and chloride in solution and by the hardne
high in hardening constituents can be used f
unsatisfactory for cooking and laundering.
parts per million makes water unfit for coo
cient to cause prohibitive soap consumptio
than that which makes water undesirable fo

The presence of approximately 200 part
250 parts of chloride, or 300 parts of sulp
slight taste. Waters containing considera
ents can be tolerated by human beings, bu
than 300 parts per million of carbonate
2,000 parts of sulphate are intolerable to
tions and individual preference, however
nificance of the terms "good" or "bad
quality of water for domestic use. Fo
a water containing 240 parts per million
as fair; in a region where the supply i
in general much better, as in the New E
would be classed as bad by most users
in this report that the classification
based only on its mineral content, a
tions afford indications of the sanitar
not permit a complete sanitary inter
only small amounts of dissolved sol
as to be unsafe for drinking.

With respect to their quality fo
classified according to their scale-f
and the probability of corrosion, an
of their use is determined. Scal
substances that go out of solution
the water. Foaming, or the forn
boiler, is caused by certain salts o
water. The corrosion or pittin
is caused by electrolytic action,
by the presence of various subs

*Rating of waters for boiler use
corroding constituents and*

Incrusting an
N

With respect to their value for irrigation, waters are classified according to their content of salts toxic to vegetation. Water containing considerable quantities of sodium salts or other alkali salts[1] is injurious to vegetation, because, through evaporation, the alkali collects in the few inches of top soil in such quantities as to interfere greatly with the growth of plants. The irrigating value of a water with respect to the amount of contained alkali is expressed by the term "alkali coefficient,"[2] which is defined as the depth of water in inches which on evaporation would yield sufficient alkali to render the soil to a depth of 4 feet injurious to the most sensitive crops. The coefficient affords a purely arbitrary means of comparing waters used for irrigation. It does not take account of certain important factors, such as the methods of irrigation and of drainage, the character of the soil, and the kind of crop, but it indicates very well the general suitability of the water for irrigation. The waters in the areas here discussed have been classified as to quality for irrigation in accordance with the following rating, which is based on ordinary irrigation practice in the United States and which indicates in a very general way the customary limitation in the use of waters having various alkali coefficients.

Classification of water for irrigation.[a]

Alkali coefficient (inches).	Class.	Remarks.
More than 18	Good	Have been used successfully for many years without special care to prevent alkali accumulation.
18 to 6.0	Fair	Special care to prevent gradual alkali accumulation has generally been found necessary except on loose soils with free drainage.
5.9 to 1.2	Poor	Care in selection of soils has been found to be imperative, and artificial drainage has frequently been found necessary.
Less than 1.2	Bad	Practically valueless for irrigation.

[a] Stabler, Herman, Some stream waters of the western United States, with chapters on sediment carried by the Rio Grande and the industrial application of water analyses: U. S. Geol. Survey Water-Supply Paper 274, p. 179, 1911. See also U. S. Geol. Survey Water-Supply Paper 398, p. 57, 1916.

ANALYSES.

The waters analyzed from the Pahrump, Mesquite, and Ivanpah basins vary in mineral content from moderate to very high. The lowest amount of total solids is 240 parts per million, from well No. 108, and the highest is 27,501, from well No. 89. Both of these waters come from the Ivanpah basin. The waters analyzed are mostly good or fair for irrigation, cooking, and drinking, but average somewhat poorer for washing and boiler use. A detailed discussion of the quality of the water from each basin will be found in the descriptions of the basins.

[1] The term "alkali" is used to designate the common salts formed on evaporation of natural waters. The principal alkali salts are sodium carbonate (sal soda), or black alkali, and sodium sulphate (Glauber's salt) and sodium chloride (table salt), or white alkalies.

[2] Stabler, Herman, Some stream waters of the western United States: U. S. Geol. Survey Water-Supply Paper 274, pp. 177–179, 1911.

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DEPARTMENT OF THE INTERIOR
JOHN BARTON PAYNE, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

Water-Supply Paper 450

CONTRIBUTIONS TO THE HYDROLOGY OF THE UNITED STATES

1919

NATHAN C. GROVER, Chief Hydraulic Engineer

WASHINGTON
GOVERNMENT PRINTING OFFICE
1920

NOTE.—The papers included in the annual volume "Contributions to the hydrology of the United States" are issued separately, with the final pagination, as soon as they are ready. The last paper will include a volume index, title-page, and table of contents for the use of those who may wish to bind the separate parts. A small edition of the bound volume will also be issued, but copies can not be supplied to those who have received all the parts. On account of the congestion of printing caused by the war no volume of the "Contributions" for 1918 was issued.

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[The letters in parentheses preceding the titles are those used to designate the papers for advance publication.]

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DEPARTMENT OF THE INTERIOR
JOHN BARTON PAYNE, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

WATER-SUPPLY PAPER 451

SURFACE WATER SUPPLY OF THE UNITED STATES

1917

PART I. NORTH ATLANTIC SLOPE DRAINAGE BASINS

NATHAN C. GROVER, Chief Hydraulic Engineer
C. H. PIERCE, C. C. COVERT, and G. C. STEVENS, District Engineers

Prepared in cooperation with the States of
MAINE, VERMONT, MASSACHUSETTS, and NEW YORK

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ILLUSTRATIONS.

ILLUSTRATIONS.

SURFACE WATER SUPPLY OF THE NORTH ATLANTIC SLOPE DRAINAGE BASINS, 1917.

AUTHORIZATION AND SCOPE OF WORK.

This volume is one of a series of 14 reports presenting results of measurements of flow made on streams in the United States during the year ending September 30, 1917.

The data presented in these reports were collected by the United States Geological Survey under the following authority contained in the organic law (20 Stat. L., p. 394):

Provided, That this officer [the Director] shall have the direction of the Geological Survey and the classification of public lands and examination of the geological structure, mineral resources, and products of the national domain.

The work was begun in 1888 in connection with special studies relating to irrigation in the arid West. Since the fiscal year ending June 30, 1895, successive sundry civil bills passed by Congress have carried the following item and appropriations:

For gaging the streams and determining the water supply of the United States, and for the investigation of underground currents and artesian wells, and for the preparation of reports upon the best methods of utilizing the water resources.

Annual appropriations for the fiscal years ending June 30, 1895–1917.

1895	$12,500
1896	20,000
1897 to 1900, inclusive	50,000
1901 to 1902, inclusive	100,000
1903 to 1906, inclusive	200,000
1907	150,000
1908 to 1910, inclusive	100,000
1911 to 1917, inclusive	150,000

In the execution of the work many private and State organizations have cooperated, either by furnishing data or by assisting in collecting data. Acknowledgments for cooperation of the first kind are made in connection with the description of each station affected; cooperation of the second kind is acknowledged on page 11.

Measurements of stream flow have been made at about 4,240 points in the United States and also at many points in Alaska and the Hawaiian Islands. In July, 1917, 1,180 gaging stations were being maintained by the Survey and the cooperating organizations. Many miscellaneous discharge measurements are made at other points. In connection with this work data were also collected in regard to precipitation, evaporation, storage reservoirs, river profiles, and water power in many sections of the country and will be made available in water-supply papers from time to time. Information in regard to publications relating to water resources is presented in the appendix to this report.

DEFINITION OF TERMS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups—(1) those that represent a rate of flow, as second-feet, gallons per minute, miners' inches, and discharge in second-feet per square mile, and (2) those that represent the actual quantity of water, as run-off in depth in inches, acre-feet, and millions of cubic feet. The principal terms used in this series of reports are second-feet, second-feet per square mile, run-off in inches, and acre-feet. They may be defined as follows:

"Second-feet" is an abbreviation for "cubic feet per second." A second-foot is the rate of discharge of water flowing in a channel of rectangular cross section 1 foot wide and 1 foot deep at an average velocity of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off (depth in inches)" is the depth to which an area would be covered if all the water flowing from it in a given period were uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

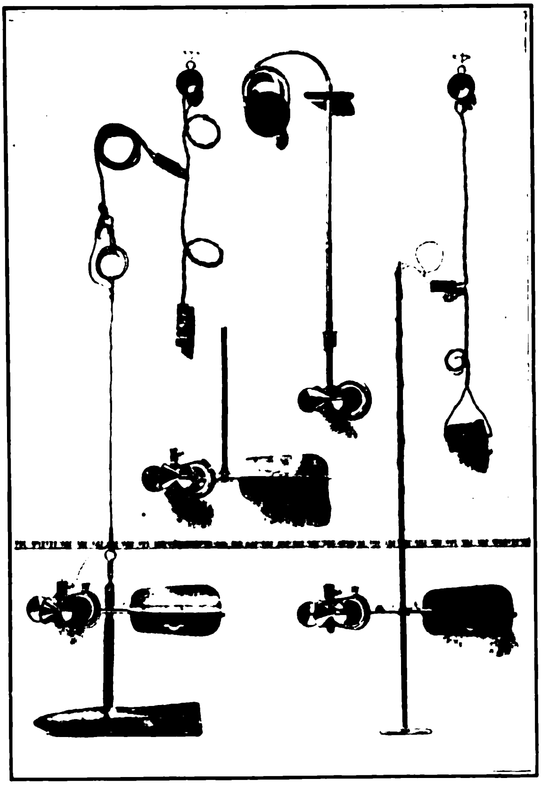
An "acre-foot," equivalent to 43,560 cubic feet, is the quantity required to cover an acre to the depth of 1 foot. The term is commonly used in connection with storage for irrigation.

The following terms not in common use are here defined:

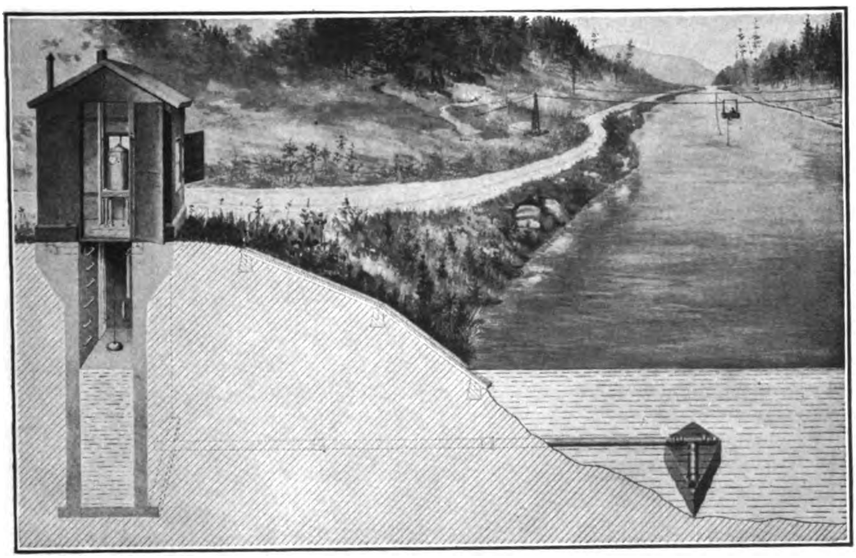
"Stage-discharge relation;" an abbreviation for the term "relation of gage height to discharge."

"Control;" a term used to designate the section or sections of the stream below the gage which determine the stage-discharge relation at the gage. It should be noted that the control may not be the same section or sections at all stages.

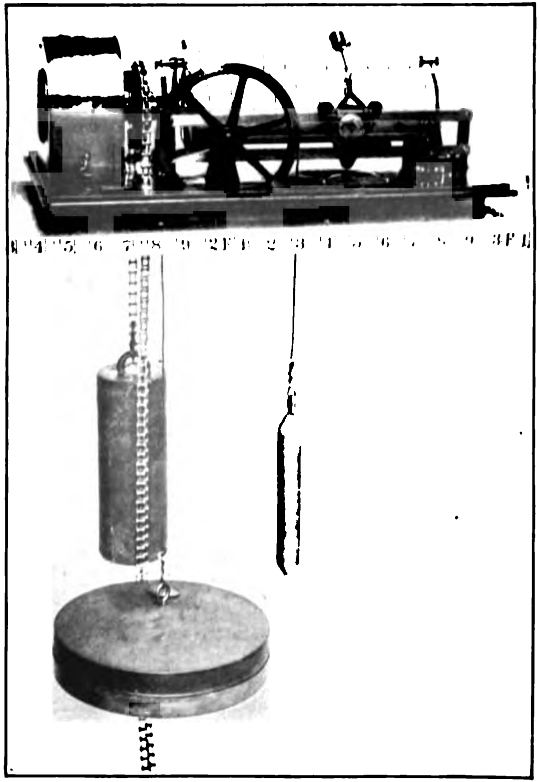
The "point of zero flow" for a gaging station is that point on the gage—the gage height—to which the surface of the river would fall if there were no flow.



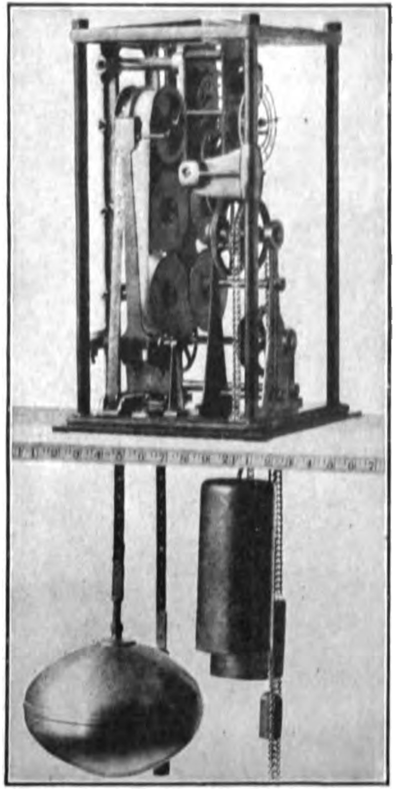
A. PRICE CURRENT METERS.



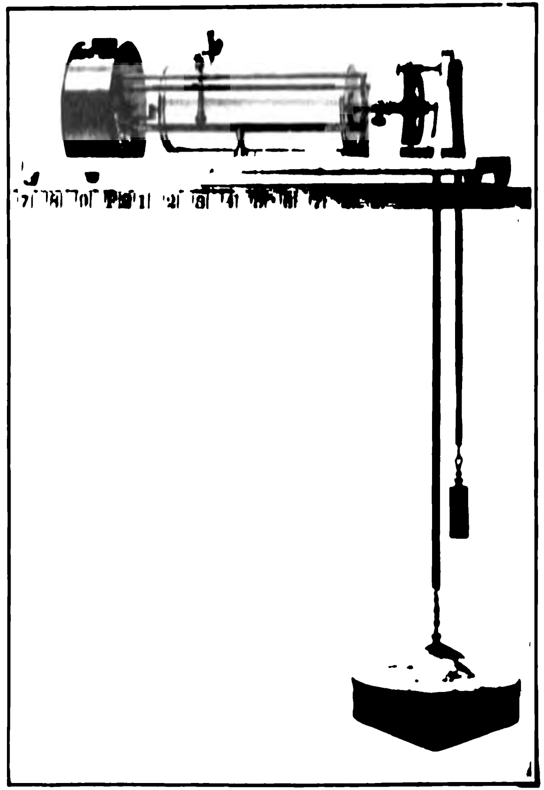
B. TYPICAL GAGING STATION.



A. STEVENS CONTINUOUS.



B. GURLEY PRINTING.



C. FRIEZ.

WATER-STAGE RECORDERS.

EXPLANATION OF DATA.

The data presented in this report cover the year beginning October 1, 1916, and ending September 30, 1917. At the beginning of January in most parts of the United States much of the precipitation in the preceding three months is stored as ground water, in the form of snow or ice, or in ponds, lakes, and swamps, and this stored water passes off in the streams during the spring break-up. At the end of September, on the other hand, the only stored water available for run-off is possibly a small quantity in the ground; therefore the run-off for the year beginning October 1 is practically all derived from precipitation within that year.

The base data collected at gaging stations consist of records of stage, measurements of discharge, and general information used to supplement the gage heights and discharge measurements in determining the daily flow. The records of stage are obtained either from direct readings on a staff gage or from a water-stage recorder that gives a continuous record of the fluctuations. Measurements of discharge are made with a current meter. (See Pls. I, II.) The general methods are outlined in standard textbooks on the measurement of river discharge.

From the discharge measurements rating tables are prepared that give the discharge for any stage, and these rating tables, when applied to the gage heights, give the discharge from which the daily, monthly, and yearly mean discharge is determined.

The data presented for each gaging station in the area covered by this report comprise a description of the station, a table giving results of discharge measurements, a table showing the daily discharge of the stream, and a table of monthly and yearly discharge and run-off.

If the base data are insufficient to determine the daily discharge, tables giving daily gage heights and results of discharge measurements are published.

The description of the station gives, in addition to statements regarding location and equipment, information in regard to any conditions that may affect the constancy of the stage-discharge relation, covering such subjects as the occurrence of ice, the use of the stream for log driving, shifting of control, and the cause and effect of backwater; it gives also information as to diversions that decrease the flow at the gage, artificial regulation, maximum and minimum recorded stages, and the accuracy of the records.

The table of daily discharge gives, in general, the discharge in second-feet corresponding to the mean of the gage heights read each day. At stations on streams subject to sudden or rapid diurnal fluctuations the discharge obtained from the rating table and the mean daily gage height may not be the true mean discharge for the day.

If gage heights are obtained with water-stage recorders the mean daily discharge may be obtained by averaging discharge at regular intervals during the day or by using the discharge integrator, an instrument operating on the principle of the planimeter and containing as an essential element the rating curve of the station.

In the table of monthly discharge the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest. As the gage height is the mean for the day it does not indicate correctly the stage when the water surface was at crest height, and the corresponding discharge was consequently larger than given in the maximum column. Likewise, in the column headed "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow in cubic feet for each second during the month. On this average flow computations recorded in the remaining columns, which are defined on page 5, are based.

ACCURACY OF FIELD DATA AND COMPUTED RESULTS.

The accuracy of stream-flow data depends primarily (1) on the permanence of the stage-discharge relation and (2) on the accuracy of observation of stage, measurements of flow, and interpretation of records.

A paragraph in the description of the station or footnotes added to the tables gives information regarding the (1) permanence of the stage-discharge relation, (2) precision with which the discharge rating curve is defined, (3) refinement of gage readings, (4) frequency of gage readings, and (5) methods of applying daily gage heights to the rating table to obtain the daily discharge.[1]

For the rating tables "well defined" indicates, in general, that the rating is probably accurate within 5 per cent; "fairly well defined," within 10 per cent; "poorly defined," within 15 to 25 per cent. These notes are very general and are based on the plotting of the individual measurements with reference to the mean rating curve.

The monthly means for any station may represent with high accuracy the quantity of water flowing past the gage, but the figures showing discharge per square mile and depth of run-off in inches may be subject to gross errors caused by the inclusion of large noncontributing districts in the measured drainage area, by lack of information concerning water diverted for irrigation or other use, or by inability to interpret the effect of artificial regulation of the flow of the river above the station. "Second-feet per square mile" and "Run-off (depth in inches)" are therefore not computed if such errors appear probable. The computations are also omitted for

[1] For a more detailed discussion of the accuracy of stream-flow data see Grover, N. C., and Hoyt, J. C., Accuracy of stream-flow data: U. S. Geol. Survey Water-Supply Paper 400, pp. 53-59, 1916.

stations on streams draining areas in which the annual rainfall is less than 20 inches. All figures representing "second-feet per square mile" and "run-off (depth in inches)" previously published by the Survey should be used with caution because of possible inherent sources of error not known to the Survey.

The table of monthly discharge gives only a general idea of the flow at the station and should not be used for other than preliminary estimates; the tables of daily discharge allow more detailed studies of the variation in flow. It should be borne in mind, however, that the observations in each succeeding year may be expected to throw new light on data previously published.

COOPERATION.

The hydrometric work in Maine was carried on in cooperation with the public utilities commission, Benjamin F. Cleaves, chairman, and Paul L. Bean, chief engineer.

In Vermont the work was carried on in cooperation with the State, which was represented by Horace F. Graham, governor, and Herbert M. McIntosh, State engineer.

The work in Massachusetts was carried on in cooperation with the Commonwealth, Samuel W. McCall, governor, and John N. Cole, chairman, commission on waterways and public lands.

Financial assistance has been rendered by the New England Power Co., the Turners Falls Power & Electric Co., the Connecticut Valley Lumber Co., the Holyoke Water Power Co., the International Paper Co., the Connecticut Power Co., and the W. H. McElwain Co.

Work in the State of New York has been conducted under cooperative agreements with the State engineer and surveyor and, since July 1, 1911, with the division of waters of the State conservation commission.

The water-stage recorder on Hudson River, at Spier Falls, N. Y., was inspected by an employee of the Adirondack Electric Power Corporation, Glens Falls, N. Y.

The station on Rappahannock River near Fredericksburg, Va., was maintained in cooperation with the Spottsylvania Power Co.

DIVISION OF WORK.

The data for stations in New England were collected and prepared for publication under the direction of C. H. Pierce, district engineer. The work in Maine was under the immediate supervision of G. C. Danforth, assistant engineer of the public utilities commission, who was assisted by E. W. Conners and F. E. Pressey. The other assistants in New England were Hardin Thweatt, H. W. Fear, M. R. Stackpole, and Hope Hearn.

Data for stations in New York were collected and prepared for publication under the direction of C. C. Covert, district engineer, who was assisted by O. W. Hartwell, E. D. Burchard, A. H. Davison, W. A. James, and Helen Kinney.

For stations in New Jersey, Maryland, and Virginia, the data were collected and prepared for publication under the direction of G. C. Stevens, district engineer, who was assisted by H. J. Jackson, B. L. Hopkins, M. I. Walters, and J. W. Moulton.

The manuscript was assembled and reviewed by W. E. Dickinson.

GAGING-STATION RECORDS.

ST. JOHN RIVER BASIN.

ST. JOHN RIVER AT VAN BUREN, MAINE.

Location.—At international bridge at Van Buren, Aroostook County, about 14 miles above Grand Falls.

Drainage area.—8,270 square miles.

Records available.—May 4, 1908, to September 30, 1917.

Gage.—Gage used since May 6, 1912, painted vertically on second pier from Van Buren end of bridge; zero of gage, 407.69 feet above sea level. From 1908 to 1911 stage was read on a vertical rod attached to pier of sawdust carrier of Hammond's mill, about 700 feet below international bridge, but as published, readings are reduced to datum of bridge gage. Gage read by W. H. Scott.

Discharge measurements.—Made from international bridge.

Channel and control.—Control practically permanent. Banks high, rocky, cleared, and not subject to overflow except in very high freshets.

Extremes of discharge.—Maximum stage recorded during year, 22.8 feet at 7 a. m. June 20 (discharge, 92,700 second-feet); minimum stage recorded, 1.4 feet at 8 a. m. September 30 (discharge, 1,740 second-feet).

Ice.—Stage-discharge relation seriously affected by ice, usually from December to March; estimates based on gage heights at Grand Falls and rating curve derived from measurements at Van Buren.

Regulation.—The little storage above for log driving probably does not materially affect the flow.

Accuracy.—Stage-discharge relation practically permanent except when affected by ice. Rating curve well defined. Gage read to tenths twice daily. Daily discharge ascertained by applying mean daily-gage height to rating table. Records good.

Cooperation.—Winter-gage heights at Grand Falls furnished by H. S. Ferguson, consulting engineer.

No discharge measurements were made at this station during the year ending September 30, 1917.

Daily discharge, in second-feet, of St. John River at Van Buren, Maine, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,040	8,470	8,150	6,320	3,280	2,190	5,090	59,200	39,600	24,400	7,240	5,590
2	2,200	8,470	10,700	6,070	3,200	2,140	5,090	63,000	36,800	29,000	6,760	5,140
3	3,250	8,470	11,000	5,720	3,120	2,240	5,290	66,600	35,000	31,100	11,900	5,140
4	3,640	7,970	11,800	5,950	3,120	2,300	5,610	65,400	34,100	25,900	13,300	5,590
5	3,440	7,720	12,500	5,610	2,980	2,300	6,070	61,900	33,600	22,900	11,100	5,140
6	3,060	7,480	13,300	5,610	2,980	2,360	7,250	57,500	34,100	20,500	9,500	5,140
7	2,880	7,240	14,900	5,190	2,840	2,360	8,960	54,500	33,200	19,200	7,970	4,700
8	2,360	7,000	14,900	5,090	2,840	2,360	12,500	55,500	31,500	17,200	7,000	4,480
9	2,360	6,280	14,500	4,990	2,770	2,300	12,900	56,500	29,400	16,300	6,520	4,050
10	2,360	6,280	14,100	4,990	2,700	2,300	13,100	57,500	28,200	15,700	6,520	3,840
11	2,360	6,050	13,100	4,800	2,580	2,360	12,900	60,800	27,800	15,100	7,970	3,640
12	2,360	6,050	10,800	4,420	2,580	2,460	13,500	64,200	31,500	15,100	8,470	3,440
13	2,700	5,820	8,310	4,420	2,460	2,410	14,500	69,000	48,500	16,000	8,980	3,440
14	3,250	5,610	7,400	4,330	2,360	2,460	15,500	73,800	61,400	16,300	8,220	3,060
15	4,260	4,990	7,140	4,330	2,460	2,460	17,400	75,000	57,000	16,300	7,240	3,060
16	5,140	4,330	7,400	4,600	2,360	2,360	18,700	74,400	52,500	15,700	6,280	2,700
17	6,520	3,420	6,840	4,800	2,360	2,360	19,200	69,600	48,000	15,100	5,590	2,530
18	8,470	3,420	6,970	4,800	2,360	2,360	21,000	61,900	59,700	14,500	5,590	2,580
19	9,760	3,580	6,840	4,800	2,300	2,300	22,800	58,600	84,900	14,500	6,520	2,530
20	11,600	4,240	7,840	4,600	2,360	2,360	27,200	59,700	91,400	13,900	7,480	2,360
21	14,500	4,160	8,310	4,600	2,300	2,300	30,200	61,900	81,000	13,000	7,720	2,360
22	19,200	3,350	8,150	4,240	2,240	2,240	32,600	61,900	69,000	12,500	7,240	2,360
23	20,800	3,580	8,310	4,090	2,240	2,240	59,200	59,700	57,500	12,800	7,000	2,200
24	18,500	4,160	8,150	3,990	2,240	2,240	70,800	59,200	48,500	14,500	6,520	2,360
25	16,300	5,090	6,570	3,900	2,360	2,360	72,600	59,700	39,600	14,200	6,520	2,360
26	13,900	3,990	6,440	3,820	2,300	2,300	69,000	60,800	33,200	12,800	6,520	2,040
27	12,200	2,640	6,190	3,740	2,300	2,300	64,200	56,500	29,000	11,400	6,520	1,890
28	11,100	3,660	6,070	3,580	2,240	2,240	63,000	52,500	27,400	10,000	6,520	1,890
29	10,600	4,890	5,840	3,580	....	2,190	60,800	47,500	25,500	8,980	6,520	1,740
30	9,500	3,660	5,720	3,420	....	2,140	58,000	43,500	24,400	7,970	5,820	1,740
31	8,980	....	6,320	3,280	....	1,930	....	41,500	....	7,480	5,590	....

NOTE.—Stage-discharge relation affected by ice Nov. 14 to Apr. 22; discharged determined by use of gage heights at Grand Falls.

Monthly discharge of St. John River at Van Buren, Maine, for the year ending Sept. 30, 1917.

[Drainage area, 8,270 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	20,800	2,040	7,730	0.935	1.08
November	8,470	2,640	5,400	.653	.73
December	14,900	5,720	9,180	1.11	1.28
January	6,320	3,280	4,630	.560	.65
February	3,280	2,240	2,580	.312	.32
March	2,460	1,930	2,300	.278	.32
April	72,600	5,090	28,200	3.41	3.80
May	75,000	41,500	60,300	7.29	8.40
June	91,400	24,400	44,400	5.37	5.99
July	31,100	7,480	16,100	1.95	2.25
August	13,300	5,590	7,500	.907	1.05
September	5,590	1,740	3,300	.399	.46
The year	91,400	1,740	16,000	1.93	26.33

MACHIAS RIVER BASIN.

MACHIAS RIVER AT WHITNEYVILLE, MAINE.

Location.—At a wooden highway bridge in Whitneyville, Washington County, 200 feet below a storage dam, 4 miles above Machias.

Drainage area.—465 square miles.

Records available.—October 17, 1903, to September 30, 1917.

Gage.—Chain installed on the wooden highway bridge October 10, 1911; prior to October 3, 1905, chain gage on the Washington County railroad bridge, three-fourths of a mile downstream; October 3, 1905, to October 9, 1911, staff gage on highway bridge at datum of present chain gage. Gage read by I. S. Albee.

Discharge measurements.—Made from railroad bridge or by wading.

Channel and control.—Practically permanent.

Extremes of discharge.—Maximum stage recorded during year, 10.8 feet at 3.45 p. m. June 18 (discharge by extension of rating curve, 6,800 second-feet); minimum stage recorded during year, 3.4 feet several times in November (discharge, 221 second-feet).

Ice.—River usually remains open at the gage, but ice farther downstream occasionally affects the stage-discharge relation.

Regulation.—Opening and closing of gates in storage dam immediately above station each day during low stages of the river cause considerable fluctuation; some log driving every year and jams of short duration occasionally occur.

Accuracy.—Stage-discharge relation practically permanent except when affected by ice. Rating curve fairly well defined between 100 and 4,000 second-feet. Gage read to half-tenths once daily. Daily discharge ascertained by applying rating table to mean daily gage height. Records fair.

Discharge measurements of Machias River at Whitneyville, Maine, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Feb. 19	E. W. Conners	a 4.80	542
May 4	F. E. Pressey	7.02	2,720
31	....do	7.00	2,850

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Machias River at Whitneyville, Maine, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	412	544	800	1,380	860	860	3,750	2,210	2,950	1,540	711	800
2	412	517	1,780	1,240	860	800	2,950	2,390	2,950	1,540	740	800
3	464	464	1,640	1,100	860	740	2,480	2,570	2,850	1,380	740	770
4	464	464	1,360	1,040	860	626	2,750	2,750	2,750	1,100	740	740
5	464	464	1,710	1,100	860	626	3,350	2,570	2,570	980	682	682
6	412	412	1,040	1,380	860	626	4,050	2,210	2,480	860	626	626
7	412	362	1,040	1,540	920	626	4,800	1,780	2,120	682	571	571
8	412	314	1,100	1,540	920	682	5,020	1,700	1,860	626	517	571
9	412	267	981	1,460	682	740	4,580	1,780	1,620	571	464	626
10	412	267	860	1,460	682	800	3,350	2,210	1,860	517	517	654
11	412	267	800	1,460	682	740	2,950	2,750	2,390	517	2,210	682
12	464	267	682	1,540	682	711	2,660	3,350	4,800	682	2,080	682
13	464	267	626	1,540	626	682	2,660	2,950	6,450	860	1,620	517
14	517	244	517	1,540	626	682	2,750	2,480	4,910	920	1,240	464
15	517	221	626	3,150	571	626	2,850	2,210	4,250	980	1,040	412
16	517	221	740	3,050	544	626	2,950	1,860	2,750	980	860	362
17	517	221	800	2,950	544	626	3,050	1,540	3,750	920	626	362
18	517	221	860	2,480	544	626	3,150	1,170	6,780	860	517	338
19	626	221	800	2,210	544	626	3,350	1,310	6,670	740	626	314
20	1,100	221	740	1,700	517	626	3,450	1,240	5,130	682	860	290
21	1,860	221	682	1,620	517	626	3,550	1,240	4,250	682	920	267
22	1,460	221	626	1,540	517	626	3,550	1,240	3,050	682	1,040	267
23	626	221	1,460	1,460	517	626	3,550	1,310	2,750	682	980	314
24	571	1,040	2,750	1,380	517	740	3,450	1,460	2,570	654	860	314
25	571	1,860	2,480	1,310	517	920	3,350	1,620	2,480	626	800	338
26	571	1,380	1,940	1,310	517	1,700	3,050	1,780	2,480	626	800	362
27	626	800	1,700	1,310	800	1,940	2,660	1,860	1,940	626	860	387
28	626	740	1,620	1,240	860	2,570	2,480	1,940	1,620	626	920	412
29	626	682	1,620	1,100	....	3,750	2,390	2,030	1,620	682	800	412
30	571	682	1,620	980	....	4,150	2,210	2,210	1,540	682	740	412
31	571	....	1,540	860	....	4,580	....	2,850	....	682	740	....

NOTE.—Stage-discharge relation affected by ice from Jan. 29 to Mar. 31; discharge estimated from gage heights, 1 discharge measurement, observer's notes, and weather records.

Monthly discharge of Machias River at Whitneyville, Maine, for the year ending Sept. 30, 1917.

[Drainage area, 465 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,860	412	600	1.29	1.49
November	1,860	221	476	1.02	1.14
December	2,750	517	1,220	2.62	3.02
January	3,150	860	1,580	3.40	3.92
February	920	517	679	1.46	1.52
March	4,580	626	1,160	2.49	2.87
April	5,020	2,210	3,240	6.97	7.78
May	3,350	1,170	2,020	4.34	5.00
June	6,780	1,540	3,210	6.90	7.70
July	1,540	517	812	1.75	2.02
August	2,210	464	884	1.90	2.19
September	800	267	492	1.06	1.18
The year	6,780	221	1,360	2.92	39.83

UNION RIVER BASIN.

WEST BRANCH OF UNION RIVER AT AMHERST, MAINE.

Location.—At highway bridge three-quarters of a mile west of Amherst post office, Hancock County, on road to Bangor, about a mile below highway bridge at old tannery dam.

Drainage area.—[illegible] square miles.

Records available.—July 25, [illegible], to September 30, 1917.

Gage.—Chain, installed June [illegible], 1911, at same datum as old vertical gage nailed to the abutment; read by Mrs. Emma Sumner.

Discharge measurements.—Made from downstream side of the bridge.

Channel and control.—Gravel; unlikely to change except in unusual flood.

Extremes of discharge.—Maximum open-water stage recorded during year, 12.25 feet at [illegible] a. m. April [illegible] (discharge, [illegible] second-feet); a stage of 13.5 feet was recorded March 29, but the stage-discharge relation was affected by ice at the time; minimum stage recorded during year, 5.4 feet several times in October, August, and September (discharge, [illegible] second-feet).

Ice.—Surface ice forms to a considerable thickness and anchor ice is found at the measuring section; stage-discharge relation seriously affected.

Regulation.—Discharge of stream only slightly affected by the operation of the few log-driving dams above the station.

Accuracy.—Stage-discharge relation practically permanent except as affected by backwater from ice and occasional log jams. Rating curve well defined below [illegible] second-feet. Gage read to half-tenths twice daily except from January 3 to April 4, when it was read twice daily three days a week. Daily discharge ascertained by applying rating table to mean daily gage height. Records fair.

Discharge measurements of West Branch of Union River at Amherst, Maine, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Dec. [illegible]	[illegible]	a [illegible]	[illegible]
Feb. [illegible]	[illegible]	a [illegible]	[illegible]
June [illegible]	[illegible]	[illegible]	[illegible]

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of West Branch of Union River at Amherst, Maine, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	83	125	392	140	190	125	1,220	798	438	438	208	83
2	72	103	580	140	182	132	1,370	768	415	392	304	83
3	72	110	532	140	173	140	1,560	738	393	392	254	83
4	63	110	532	156	173	132	1,720	738	392	347	226	132
5	55	110	605	173	173	125	966	682	370	347	226	245
6	55	103	630	190	140	118	1,370	682	370	254	190	140
7	55	96	605	190	110	110	1,880	682	370	217	156	72
8	55	83	556	182	110	118	1,800	630	370	190	118	63
9	72	83	556	173	110	125	1,640	556	347	173	110	55
10	68	83	532	173	110	140	1,520	738	369	156	284	63
11	55	83	461	173	103	140	1,440	896	605	156	369	63
12	55	78	461	103	96	125	1,330	896	930	190	304	63
13	55	78	428	110	96	125	1,250	830	1,000	199	304	72
14	72	72	392	245	96	125	1,220	798	930	190	190	63
15	72	68	380	369	103	132	1,220	798	862	173	110	63
16	63	68	358	325	110	132	1,220	738	830	173	63	63
17	55	68	347	284	110	140	1,180	656	966	148	55	63
18	55	68	336	264	103	156	1,180	580	1,800	140	63	63
19	190	68	314	245	96	173	1,250	484	1,370	125	83	63
20	347	68	304	226	96	164	1,330	461	1,250	118	90	68
21	347	68	304	208	96	156	1,370	438	1,180	110	110	72
22	325	78	347	199	90	182	1,560	415	1,040	103	96	72
23	284	72	532	190	90	199	1,520	415	862	110	83	63
24	96	78	532	190	83	226	1,480	415	798	118	96	63
25	236	325	461	190	110	347	1,440	392	682	110	118	63
26	208	438	415	182	132	580	1,400	369	580	96	103	72
27	190	347	392	173	156	710	1,250	347	484	96	83	59
28	173	245	347	190	140	830	1,150	325	438	96	72	55
29	140	226	325	208	......	930	1,040	347	415	96	72	55
30	125	245	284	199	......	1,000	930	438	438	304	90	55
31	125	......	284	190	......	1,070	......	461	......	236	90	......

NOTE.—Stage-discharge relation affected by ice Dec. 15 to Apr. 3; discharge ascertained from gage heights, two discharge measurements, observer's notes, and weather records; affected by log jams Apr. 20-25, and discharge determined by comparison with near-by streams. Discharge estimated June 5-7 when gage was removed for repairs to bridge.

Monthly discharge of West Branch of Union River at Amherst, Maine, for the year ending Sept. 30, 1917.

[Drainage area, 140 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	347	55	126	0.900	1.04
November	438	68	128	.914	1.02
December	630	284	437	3.12	3.60
January	369	103	197	1.41	1.63
February	190	83	121	.864	.90
March	1,070	110	287	2.05	2.36
April	1,880	930	1,360	9.71	10.83
May	896	325	597	4.26	4.91
June	1,800	347	710	5.07	5.66
July	438	96	193	1.38	1.59
August	369	55	152	1.09	1.26
September	245	55	76.4	.546	.61
The year	1,880	55	365	2.61	35.41

PENOBSCOT RIVER BASIN.

WEST BRANCH OF PENOBSCOT RIVER AT MILLINOCKET, MAINE.

Location.—At Quakish Lake dam and Millinocket mill of Great Northern Paper Co., at Millinocket, Penobscot County.

Drainage area.—1,880 square miles.

Records available.—January 11, 1901, to September 30, 1917.

Gages.—Water-stage recorder at Quakish Lake dam and gages in forebay and tailrace at mill.

Channel and control.—Crest of concrete dam.

Discharge.—Flow computed by considering the flow over the dam, the flow through the wheels, and the water used through the log sluices and filters. The wheels were rated at Holyoke, Mass., before being placed in position and were tested later by numerous tube-float and current-meter measurements. When the flow of the river is less than 2,500 second-feet, all the water generally flows through the wheels of the mill.

Ice.—Determination of discharge not seriously affected by ice; Ferguson Pond, just above entrance to canal, eliminates effect from anchor ice.

Regulation.—Dams at outlets of North Twin and Chesuncook lakes store water on a surface of about 65 square miles, with a capacity of about 32 billion cubic feet. Except during the time (usually in August) when excess water has to be supplied for log driving on the river below Millinocket and for a short time during the spring freshet, run-off is regulated by storage. Records corrected for storage.

Cooperation.—Records furnished by engineers of Great Northern Paper Co.

Monthly discharge of West Branch of Penobscot River at Millinocket, Maine, for the year ending Sept. 30, 1917.

[Drainage area, 1,880 square miles.]

Month.	Discharge in second-feet.			Corrected run-off (depth in inches on drainage area).
	Observed mean.	Corrected for storage.		
		Mean.	Per square mile.	
October	2,240	1,790	0.952	1.10
November	2,250	1,820	.968	1.08
December	2,220	3,560	1.89	2.18
January	2,380	1,660	.883	1.02
February	2,230	828	.440	.46
March	2,590	1,640	.872	1.00
April	2,950	7,250	3.86	4.31
May	7,650	10,600	5.64	6.50
June	12,800	13,300	7.04	7.86
July	4,720	4,230	2.25	2.59
August	5,950	5,920	3.15	3.63
September	2,810	2,300	1.22	1.36
The year	4,250	4,570	2.43	33.09

WEST BRANCH OF PENOBSCOT RIVER NEAR MEDWAY, MAINE.

Location.—Just above Nichatou Rapids, half a mile above mouth of East Branch of Penobscot River and town of Medway, Penobscot County, and 2 miles below East Millinocket.

Drainage area.—2,100 square miles.

Records available.—February 20, 1916, to September 30, 1917.

Gage.—Chain gage on left bank used February 20 to August 4, 1916; read by A. T. Read; Gurley 7-day water-stage recorder on left bank used since August 4, 1916.

Discharge measurements.—Made from cable.

Channel and control.—Bed fairly smooth at measuring section; covered with rocks and boulders above and below gage. Channel divides a few hundred feet below gage, but practically entire flow passes to left of Nichatou Rapids; shifts occasionally.

Extremes of discharge.—Maximum stage for period of records, from water-stage recorder, 9.88 feet at 1 p. m., June 16, 1917 (discharge, from extension of rating curve, about 20,000 second-feet); minimum stage recorded, 1.45 feet at 9.45 a. m., January 7, 1917 (discharge, 585 second-feet).

Ice.—Ice forms along banks but main channel remains open; stage-discharge relation not seriously affected.

Regulation.—Flow at ordinary stages completely regulated by dams and storage reservoirs above station.

Accuracy.—Stage-discharge relation changed occasionally during high water when débris was removed from right side on control. Rating curve used February 20, 1916, to June 20, 1917, fairly well defined below 7,000 second-feet; curve used June 21 to September 30, 1917, fairly well defined between 2,000 and 7,000 second-feet. Chain gage read to tenths once daily to August 4, 1916; water-stage recorder used since that date. Daily discharge ascertained by applying daily gage height to rating table until August 4, 1916; August 5 to December 23, 1916, May 15–19, 1917, and June 12–28, 1917, by applying to rating table the mean of 12 bihourly gage heights, and for rest of year by discharge integrator. Records fair.

Cooperation.—Several discharge measurements made by T. W. Clark, hydraulic engineer, Oldtown, Maine.

Discharge measurements of West Branch of Penobscot River near Medway, Maine, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 11	E. W. Conners	3.26	2,170	Jan. 7	E. W. Conners	a4.22	3,280
15	do	2.24	1,160	June 8	F. E. Pressey	5.21	5,650
Nov. 11	T. W. Clark	2.60	1,420	30	H. A. Lancaster	5.22	5,960
Jan. 7	E. W. Conners	1.55	630				

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of West Branch of Penobscot River near Medway, Maine, for the years ending Sept. 30, 1916 and 1917.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1916.							
1	2,630	3,810	3,810	3,250	3,420	3,250	2,980
2	2,930	2,930	3,610	3,420	1,800	3,250	3,010
3	2,630	3,090	3,810	3,250	2,780	3,090	2,780
4	2,360	2,490	4,020	2,780	2,930	3,420	2,360
5	2,000	2,490	3,610	3,610	4,950	3,170	2,690
6	2,490	4,020	3,810	3,250	4,700	2,860	2,880
7	2,490	4,020	2,110	4,240	3,610	2,860	2,980
8	2,780	4,240	4,020	3,250	4,020	3,810	3,010
9	2,630	4,020	3,810	3,420	3,420	5,340	3,090
10	2,780	3,810	3,810	3,250	3,090	5,080	2,630
11	2,780	4,020	3,810	1,500	3,420	4,820	2,630
12	1,800	4,020	3,420	3,610	2,490	4,700	2,630
13	2,780	3,810	4,240	3,810	4,240	4,240	2,420
14	2,780	3,810	1,700	3,610	4,240	3,610	2,560
15	2,780	4,240	3,090	3,250	4,240	4,020	2,560
16	2,600	2,630	2,930	3,250	3,810	4,240	2,780
17	2,490	4,020	3,090	3,250	4,020	4,240	2,420
18	2,630	4,470	3,090	2,360	4,240	4,240	2,360
19	2,000	4,470	3,090	3,810	3,090	3,610	2,680
20	2,780	4,240	3,250	4,020	3,250	3,170	2,630
21	2,490	4,240	2,630	5,470	3,250	2,700	2,560
22	2,780	4,470	3,420	4,020	2,930	2,930	2,560
23	2,630	2,780	4,020	4,020	2,930	2,930	2,560
24	2,780	3,810	4,020	3,250	2,930	3,090	2,360
25	2,780	3,610	4,020	2,110	3,420	3,170	2,420
26	2,930	3,610	3,810	3,250	3,420	3,010	2,560
27	3,610	3,610	3,810	3,090	3,420	2,630	2,360
28	2,930	3,610	1,800	2,930	3,250	2,930	2,360
29	3,250	3,610	2,930	2,930	3,420	2,930	2,360
30	3,610	2,930	2,230	3,090	3,420	3,010	2,360
31	4,020	....	3,610	....	3,250	3,010	....

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1916-17.												
1	2,230	2,300	3,340	3,050	3,250	2,800	3,500	3,900	8,000	8,350	5,510	2,980
2	2,230	2,420	3,810	2,950	3,250	2,850	3,800	3,750	7,600	8,350	5,200	2,840
3	2,300	2,420	2,560	3,050	3,100	2,800	4,150	3,900	5,700	8,500	6,360	2,680
4	2,300	2,630	3,090	3,000	2,650	2,500	4,050	3,650	5,150	8,100	7,550	2,680
5	2,300	2,170	2,930	2,950	2,800	2,400	3,850	3,800	5,250	7,490	7,570	2,570
6	2,230	2,300	2,930	3,000	2,800	2,600	3,950	3,450	6,500	7,270	8,300	2,900
7	2,230	2,420	2,930	2,850	2,600	2,800	4,450	4,000	6,050	6,460	7,660	3,470
8	2,110	2,700	3,090	3,150	2,600	2,800	4,550	4,050	5,700	4,450	7,160	3,470
9	2,230	2,860	3,010	3,650	2,650	2,750	4,400	4,150	5,000	5,390	7,080	2,980
10	2,060	2,860	2,630	3,900	2,650	2,850	4,300	4,000	3,550	5,200	7,430	3,220
11	2,170	2,780	3,090	4,250	2,350	2,600	4,250	4,400	7,250	3,310	8,200	2,880
12	2,170	2,300	2,930	4,200	2,500	2,800	4,100	4,150	11,800	3,420	8,150	2,840
13	2,170	2,560	3,090	3,200	2,500	3,000	3,650	4,850	13,000	7,020	8,200	2,790
14	2,300	2,860	2,930	2,800	2,500	3,050	3,900	8,250	12,400	6,280	7,490	2,780
15	2,000	2,780	2,930	3,100	2,350	3,200	3,450	12,600	13,600	5,100	6,510	3,910
16	2,060	2,860	2,560	3,350	2,350	3,100	3,700	13,300	14,300	4,650	6,330	2,430
17	2,300	2,930	2,560	3,300	2,250	3,100	3,800	13,300	15,800	4,520	5,940	2,980
18	2,300	2,780	2,930	3,200	1,960	2,650	3,900	13,000	18,600	4,360	6,640	2,570
19	2,300	2,490	3,010	3,250	2,500	3,100	3,950	13,000	19,200	4,110	6,620	2,630
20	2,360	2,700	2,930	3,650	2,650	3,100	4,050	11,800	19,800	4,650	7,160	2,570
21	2,420	3,010	2,930	3,500	2,650	3,100	4,300	11,800	19,500	4,110	6,780	2,730
22	2,420	2,930	2,930	4,200	2,800	3,100	4,400	10,000	18,800	3,580	6,690	2,930
23	2,420	2,420	3,090	4,200	2,800	3,100	4,750	10,600	18,000	4,320	5,890	2,460
24	2,490	2,560	2,850	3,800	2,800	3,050	4,650	10,600	17,200	4,320	3,830	2,530
25	2,360	2,420	2,800	3,800	2,600	2,750	4,350	9,150	16,100	3,630	2,840	2,780
26	2,420	2,060	2,800	3,700	2,700	2,950	4,050	10,200	15,800	3,090	3,260	2,780
27	2,490	2,300	2,900	3,350	2,900	3,350	3,800	11,000	14,600	2,780	4,450	2,880
28	2,300	2,490	2,950	3,050	2,800	4,000	4,250	11,000	11,200	3,190	4,520	2,680
29	2,060	2,560	3,100	3,250	....	4,350	3,150	9,350	8,450	3,970	3,910	2,930
30	2,170	2,780	3,250	3,400	....	4,250	3,800	8,200	6,570	4,030	3,220	2,580
31	2,360	....	3,100	3,250	....	4,150	....	8,300	....	3,910	3,630	....

NOTE.—Stage-discharge relation not seriously affected by ice. Discharge estimated Jan. 29-30, Feb. 1-4, 10-17, 19-24, Mar. 17-23 and May 20-22, when water-stage recorder was not in operation.

Monthly discharge of West Branch of Penobscot River near Medway, Maine, for the years ending Sept. 30, 1916 and 1917.

[Drainage area, 2,100 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1916.					
March	4,020	1,800	2,740	1.30	1.50
April	4,470	2,490	3,700	1.76	1.96
May	4,240	1,700	3,370	1.60	1.84
June	5,470	1,500	3,340	1.59	1.77
July	4,950	1,800	3,400	1.65	1.90
August	5,340	2,630	3,530	1.68	1.94
September	3,010	2,360	2,600	1.24	1.38
1916–17.					
October	2,490	2,000	2,270	1.08	1.24
November	3,010	2,060	2,590	1.23	1.37
December	3,810	2,560	2,970	1.41	1.63
January	4,250	2,800	3,400	1.62	1.87
February	3,250	1,960	2,650	1.26	1.31
March	4,350	2,400	3,060	1.46	1.68
April	4,750	3,150	4,040	1.92	2.14
May	13,300	3,450	7,980	3.80	4.38
June	19,800	3,550	11,700	5.57	6.21
July	8,500	2,780	5,090	2.42	2.79
August	8,300	2,840	6,130	2.92	3.37
September	3,910	2,430	2,850	1.36	1.52
The year	19,800	1,960	4,570	2.18	29.51

PENOBSCOT RIVER AT WEST ENFIELD, MAINE.

Location.—At steel highway bridge 1,000 feet below mouth of Piscataquis River and 3 miles west of Enfield railroad station, Penobscot County.

Drainage area.—6,600 square miles.

Records available.—January 1, 1902, to September 30, 1917.

Gages.—Friez water-stage recorder on left bank, downstream side on left bridge abutment, used since December 11, 1912; standard chain gage on upstream side of bridge, used prior to that date; gages set to same datum.

Discharge measurements.—Made from bridge.

Channel and control.—Channel at gage broken by four bridge piers; straight above and below the gage. Banks high and rocky and not subject to overflow. Control is at Passadumkeag Rips, about 5 miles below the gage; a wing dam at this point is overflowed at about gage height 5.5 feet.

Ice.—Stage-discharge relation usually affected by ice from December to April; discharge ascertained by comparison with records at Sunkhaze Rips collected by Thomas W. Clark.

Extremes of discharge.—Maximum stage during year, from water-stage recorder, 17.7 feet at 4 to 8 a. m. June 19 (discharge, from extension of rating curve, about 87,900 second-feet); minimum stage during year, from water-stage recorder, 1.98 feet at 11 a. m. October 8 (discharge, 3,190 second-feet).

Regulation.—Flow since 1900 largely controlled by storage, principally in the lakes tributary to the West Branch. Results not corrected for storage.

Accuracy.—Stage-discharge relation practically permanent except as affected by ice and occasionally by logs. Rating curve well defined. Operation of water-stage recorder satisfactory throughout the year. Daily discharge ordinarily ascertained by applying rating table to average of 24 hourly gage heights; at times of serious fluctuation in stage the daily discharge is ascertained by using the average discharge of 12 two-hour periods. Records good.

Cooperation.—Gage-height record furnished and discharge computed by T. W. Clark, hydraulic engineer, Oldtown, Maine. Several discharge measurements were made by students of University of Maine under direction of Prof. A. C. Lyon.

Discharge measurements of Penobscot River at West Enfield, Maine, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	Sec.-ft.			Feet.	Sec.-ft.
Oct. [illegible]	University of Maine students	[illegible]	[illegible]	Oct. [illegible]	University of Maine students	5.15	12,100
[illegible]	do	[illegible]	[illegible]	Nov. [illegible]	do	3.16	5,000
[illegible]	do	[illegible]	[illegible]	[illegible]	T. W. Clark	a2.79	4,000
[illegible]	do	[illegible]	[illegible]	Jan. 11	H. A. Lancaster	a5.32	10,200
[illegible]	H. A. Lancaster	[illegible]	[illegible]	Apr. [illegible]	T. W. Clark	a9.36	22,100
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	do	11.93	44,300
[illegible]	University of Maine students	[illegible]	[illegible]	June [illegible]	H. A. Lancaster	12.34	[illegible]
				[illegible]	do	17.63	[illegible]

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Penobscot River at West Enfield, Maine, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	15,600	10,000
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	16,000	9,120
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17,600	8,400
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19,700	8,120
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19,400	7,730
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17,600	7,380
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17,600	7,520
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	15,200	7,840
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	13,600	7,440
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	13,900	6,900
11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17,900	7,120
12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19,500	7,000
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17,600	7,120
14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	16,200	6,900
15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	14,100	6,000
16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12,500	7,400
17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12,000	5,380
18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11,500	5,600
19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12,000	5,400
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12,100	5,100
21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12,500	5,300
22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12,100	5,400
23	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12,100	5,670
24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11,000	4,730
25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	14,000	11,100	5,000
26	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	13,700	13,300	5,100
27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11,000	4,900
28	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11,300	4,900
29	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	9,570	10,700	4,230
30	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	9,570	9,570	4,230
31	[illegible]		[illegible]	[illegible]		[illegible]		35,400		12,900	9,570	

Note.—Stage-discharge relation affected by ice Nov. [illegible], 22, 23, and Dec. 12 to Apr. 17, and by log jams Aug. [illegible]; discharge ascertained by comparison with records at Sunkhaze Rips, using a reduction factor obtained by comparing records obtained under normal conditions.

Monthly discharge of Penobscot River at West Enfield, Maine, for the year ending Sept. 30, 1917.

[Drainage area, 6,600 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	13,000	3,730	6,330	0.959	1.10
November	8,400	4,300	5,820	.882	.98
December	34,700	7,170	14,300	2.17	2.50
January	12,800	6,520	9,190	1.39	1.60
February	7,300	5,070	6,030	.914	.95
March	27,900	4,980	7,780	1.18	1.36
April	55,600	23,700	36,700	5.56	6.20
May	35,100	21,800	27,200	4.12	4.75
June	86,400	15,400	38,700	5.86	6.54
July	22,500	9,570	14,200	2.15	2.48
August	19,700	9,570	14,100	2.14	2.47
September	10,000	4,730	6,480	.982	1.10
The year	86,400	3,730	15,600	2.36	32.04

EAST BRANCH OF PENOBSCOT RIVER AT GRINDSTONE, MAINE.

Location.—At Bangor & Aroostook Railroad bridge half a mile south of railroad station at Grindstone, Penobscot County, one-eighth mile above Grindstone Falls, and about 8 miles above confluence with West Branch at Medway.

Drainage area.—1,100 square miles; includes 270 square miles of Chamberlain Lake drainage basin.

Records available.—October 23, 1902, to September 30, 1917.

Gage.—Chain attached to railroad bridge; read by R. D. Porter.

Discharge measurements.—Made from railroad bridge.

Channel and control.—Practically permanent; stream confined by abutments of bridge and broken by one pier at ordinary stages; velocity of current medium at moderate and high stages but sluggish at low water.

Extremes of discharge.—Maximum stage recorded during year, 12.6 feet at 4.20 p. m. June 19 (discharge, 17,000 second-feet); minimum stage recorded during year, 4.1 feet October 11 to 13 (discharge, 210 second-feet).

Ice.—Ice forms to a considerable thickness at the gage and down to the head of Grindstone Falls, and although the falls usually remain open during the greater part of the winter, the stage-discharge relation is somewhat affected.

Regulation.—Several dams maintained at outlets of a number of lakes and ponds near source of river are regulated for log driving; during the summer and fall gates are generally left open. The basin of the East Branch since about 1840 includes about 270 square miles of territory tributary to Chamberlain Lake that formerly drained into the St. John River basin, the diversion being made through what is known as the Telos canal. Results not corrected for storage and diversions.

Accuracy.—Stage-discharge relation occasionally affected by backwater from logs jams at station and at Grindstone Falls immediately below, and by ice during winter. Rating curve well defined below 9,000 second-feet. Gage read to tenths twice daily except during the winter when it was read three times a week. Daily discharge ascertained by applying rating table to mean daily gage height. Record good, except for winter months for which they are fair.

Discharge measurements of East Branch of Penobscot River at Grindstone, Maine, during the year ending Sept. 30, 1917.

[Made by R. W. Conners.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Jan. 7	a 6.45	1,000
Feb. 1	a 6.10	777
27	a 5.65	583

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of East Branch of Penobscot River at Grindstone, Maine, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	580	580	5,770	2,120	790	533	3,320	6,210	4,290	a 3,140	2,480	1,900
2	533	560	5,130	1,990	790	533	3,140	6,210	4,290	3,880	2,450	a 1,810
3	406	560	3,700	1,740	750	505	2,980	5,980	4,480	4,000	2,280	1,600
4	505	560	2,620	1,520	750	505	2,980	5,980	4,000	3,700	2,120	1,520
5	505	620	2,620	1,330	715	505	2,790	5,770	4,290	3,510	a 2,120	1,380
6	455	690	2,420	1,130	715	505	3,320	a 5,330	4,480	4,080	2,120	1,250
7	360	620	2,960	1,980	715	506	3,700	4,910	4,480	4,490	1,960	1,130
8	360	620	2,790	1,039	715	506	7,350	4,290	4,700	a 4,490	1,690	1,130
9	360	620	2,620	970	715	505	6,060	4,290	4,700	4,290	1,660	a 1,130
10	286	680	2,620	875	715	505	4,490	4,910	a 4,000	4,490	2,620	1,080
11	225	620	1,900	830	715	505	3,980	5,330	3,510	4,910	3,320	1,020
12	210	620	1,380	830	715	505	3,980	5,770	5,980	4,900	a 2,790	920
13	210	620	1,380	830	690	505	3,980	a 5,770	8,050	4,910	2,280	920
14	338	505	1,380	1,020	650	505	4,080	5,550	7,120	4,490	1,900	880
15	560	406	1,380	1,250	620	505	4,080	6,680	7,580	a 4,080	1,880	880
16	650	406	1,190	1,450	580	505	4,080	6,680	6,880	3,700	1,810	a 880
17	533	430	830	1,740	580	506	4,290	6,210	a 7,000	3,700	1,810	750
18	455	455	920	1,980	580	506	5,770	6,210	13,100	4,290	1,810	750
19	455	430	1,020	1,740	560	506	6,210	6,210	16,700	4,490	a 1,810	680
20	1,130	406	1,190	1,330	560	505	7,510	a 5,770	15,300	4,490	1,880	680
21	2,200	406	1,380	1,250	560	506	8,060	5,330	11,800	4,080	1,900	680
22	1,910	382	1,380	1,250	533	506	8,530	5,330	9,010	a 4,080	2,120	660
23	1,320	360	1,910	1,190	533	580	9,730	5,330	7,580	4,290	1,810	a 660
24	970	a 406	2,280	1,130	533	680	10,000	5,770	a 6,290	5,330	1,900	620
25	830	455	2,960	1,130	533	790	8,770	5,550	4,910	5,080	2,620	620
26	750	a 506	3,510	1,020	533	920	7,350	5,550	4,480	4,290	a 2,250	620
27	690	560	2,960	920	506	1,320	7,120	a 5,550	3,140	2,980	1,810	620
28	620	a 620	2,620	875	505	3,600	7,120	5,330	2,620	2,790	1,900	620
29	620	a 680	2,380	830	......	4,290	a 6,790	4,910	1,830	a 2,620	1,900	580
30	620	750	2,120	830	......	3,510	6,430	4,490	2,280	2,450	1,810	a 580
31	620	......	2,120	790	......	3,320	......	4,490	......	2,690	1,900	......

a Discharge estimated on account of no gage height.

NOTE.—Stage-discharge relation affected by ice Nov. 16-22, and Dec. 9 to Apr. 17; discharge ascertained from gage heights, three discharge measurements, observer's notes, and weather records.

Monthly discharge of East Branch of Penobscot River at Grindstone, Maine, for the year ending Sept. 30, 1917.

[Drainage area, 1,100 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	2,200	210	650	0.591	0.68
November	750	360	538	.489	.55
December	5,770	830	2,310	2.10	2.42
January	2,120	790	1,230	1.12	1.29
February	790	505	638	.580	.60
March	4,290	505	974	.885	1.02
April	10,000	2,790	5,620	5.11	5.70
May	6,660	4,290	5,540	5.04	5.81
June	16,700	1,810	6,290	5.72	6.38
July	5,330	2,450	4,020	3.65	4.21
August	3,320	1,660	2,090	1.90	2.19
September	1,960	560	949	.863	.96
The year	16,700	210	2,580	2.35	31.81

MATTAWAMKEAG RIVER AT MATTAWAMKEAG, MAINE.

LOCATION.—At Maine Central Railroad bridge at village of Mattawamkeag, Penobscot County, half a mile above mouth of river.

DRAINAGE AREA.—1,500 square miles.

RECORDS AVAILABLE.—August 26, 1902, to September 30, 1917.

GAGE.—Chain fastened to railroad bridge; read by W. T. Mincher.

DISCHARGE MEASUREMENTS.—Made from the bridge; low-water measurements made by wading at a point about a mile above station.

CHANNEL AND CONTROL.—Practically permanent; channel at bridge broken by two piers.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.3 feet at 7 a. m. and 5 p. m. June 20 (discharge, 23,300 second-feet); minimum stage recorded, 3.6 feet several times in October (discharge, 390 second-feet).

ICE.—Stage-discharge relation usually affected by ice for several months each winter.

REGULATION.—Dams are maintained at outlets of several large lakes and ponds, but the stored water is used only for log driving.

ACCURACY.—Stage-discharge relation occasionally affected by backwater from log jams and, during winter, by ice. Rating curve fairly well defined between 500 and 15,000 second-feet. Gage read to tenths twice daily except from December 13 to April 7, when it was read twice a week. Daily discharge ascertained by applying mean daily gage height to rating table. Open-water records good; winter records fair.

COOPERATION.—Several discharge measurements furnished by T. W. Clark, hydraulic engineer, Oldtown, Maine.

Records for 1916, revised by means of data obtained in 1917, are republished herewith and supersede those published in Water-Supply Paper 431.

Discharge measurements of Mattawamkeag River at Mattawamkeag, Maine, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 12	T. W. Clark	3.91	560	Mar. 10	H. A. Lancaster	a 7.10	710
Nov. 29	.....do	5.18	1,750	30	.....do	a 10.45	5,110
Jan. 9	E. W. Comers	a 9.46	1,930	Apr. 19	F. E. Pressey	9.84	13,800
Feb. 7	.....do	a 7.85	1,370	Aug. 26	H. A. Lancaster	4.95	1,470

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Mattawamkeag River at Mattawamkeag, Maine, for the years ending Sept. 30, 1916 and 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915-16.												
1	1,470	1,470	2,040	6,140	985	1,200	2,000	5,000	2,000	1,000	1,290	445
2	1,300	1,150	2,170	6,140	950	1,300	3,600	5,600	2,300	1,600	1,130	445
3	1,190	1,150	2,300	6,140	900	1,350	4,600	5,000	2,000	1,730	1,000	445
4	1,140	1,240	2,300	6,300	860	1,300	7,400	5,000	1,950	2,100	900	445
5	1,040	1,140	2,530	6,300	780	1,200	9,200	5,000	1,800	5,200	820	380
6	1,140	1,040	2,310	6,720	700	1,300	10,100	5,000	1,600	5,400	820	380
7	1,040	960	[illegible]	7,220	740	1,300	9,200	5,800	1,400	5,400	770	445
8	960	960	1,870	7,700	740	1,350	7,900	5,900	1,400	5,200	900	445
9	900	900	1,840	7,210	740	1,350	6,900	4,200	1,600	4,700	1,130	380
10	750	860	1,730	6,460	740	1,350	6,400	4,300	1,730	3,700	1,130	380
11	780	960	1,710	5,920	740	1,350	6,370	4,600	1,950	2,780	1,130	380
12	780	960	1,770	5,250	740	1,350	6,370	3,700	2,230	2,300	1,130	445
13	780	960	1,770	4,300	740	1,350	6,370	3,140	3,230	3,700	1,000	445
14	750	960	1,840	3,900	700	1,300	6,680	2,600	3,040	1,730	900	445
15	700	865	2,100	2,300	700	1,300	6,950	2,600	2,950	1,570	770	380
16	700	1,300	2,370	1,900	700	1,300	7,100	1,820	2,530	1,300	770	472
17	700	1,420	2,440	1,840	665	1,190	7,100	1,920	2,300	1,000	600	600
18	700	1,470	2,440	1,790	665	1,190	7,730	1,900	2,230	1,400	600	600
19	700	1,520	2,440	1,650	665	1,140	8,380	2,390	2,300	1,400	600	600
20	630	1,710	3,000	1,300	630	1,000	8,600	2,700	2,700	1,000	500	770
21	630	1,710	3,370	1,530	630	1,000	8,900	2,520	2,600	1,230	500	600
22	630	1,900	3,540	1,410	598	1,040	9,140	2,300	2,300	1,130	500	600
23	530	2,110	3,540	1,350	598	960	8,900	2,300	1,900	1,000	500	600
24	740	2,240	[illegible]	1,350	665	976	8,250	2,730	1,600	1,130	500	500
25	700	1,970	3,300	1,300	740	960	7,800	2,570	1,400	1,130	500	500
26	770	1,540	4,000	1,300	820	730	7,350	2,600	1,200	1,230	500	500
27	985	1,710	4,440	1,240	985	790	6,730	3,940	1,600	1,750	500	500
28	1,240	1,710	4,900	1,240	985	750	6,000	2,530	1,800	2,000	500	500
29	1,240	1,710	5,240	1,130	1,140	750	5,350	2,160	2,000	2,400	500	445
30	1,350	1,540	5,440	1,140	......	1,240	5,600	2,700	1,250	1,500	445	445
31	1,470	......	5,900	1,000	......	1,900	......	2,380	......	1,520	445	......
1916-17.												
1	445	1,340	2,700	3,420	1,400	806	7,100	11,300	6,370	5,400	1,280	1,300
2	500	1,450	4,400	3,250	1,400	985	7,900	9,960	6,140	5,400	1,820	1,300
3	500	1,340	6,140	2,700	1,400	850	8,380	9,140	5,600	5,400	2,000	1,450
4	500	1,340	[illegible]	2,270	1,340	850	8,900	8,900	4,330	5,200	2,230	1,570
5	500	1,230	6,370	2,300	1,340	850	9,420	8,380	4,400	4,800	2,300	1,450
6	500	1,120	6,550	1,850	1,340	730	11,500	8,100	4,400	4,000	2,700	1,230
7	500	1,030	[illegible]	2,000	1,340	690	11,000	7,600	4,200	4,200	2,300	1,230
8	445	1,030	[illegible]	1,570	1,250	690	12,300	7,200	4,400	3,630	1,950	1,230
9	380	940	[illegible]	1,620	1,230	690	12,700	7,300	3,900	3,040	1,400	1,130
10	380	550	6,370	1,500	1,150	690	12,400	8,000	3,420	2,300	1,200	1,130
11	380	550	5,460	1,450	1,130	770	12,200	8,900	3,630	2,000	1,800	1,130
12	500	770	4,500	1,340	1,130	770	11,000	9,420	5,200	1,950	2,530	1,000
13	500	770	[illegible]	1,520	1,130	770	11,400	10,300	8,640	1,950	2,700	1,000
14	520	770	3,200	2,530	1,130	770	11,500	9,960	9,960	1,800	2,000	985
15	520	770	2,570	2,570	1,200	770	11,800	9,960	10,500	2,230	1,000	850
16	1,320	770	2,380	3,230	1,320	770	11,000	10,200	10,900	2,300	1,250	730
17	1,130	770	1,520	3,620	985	770	11,400	11,200	10,600	2,230	1,130	600
18	1,130	770	1,620	3,420	940	770	11,900	8,540	16,400	2,230	1,000	570
19	1,130	690	2,180	3,420	860	770	12,400	7,350	21,600	2,300	940	570
20	1,320	690	2,230	3,230	820	770	13,900	6,370	23,300	2,700	940	500
21	2,530	730	2,380	3,140	770	770	14,500	5,910	22,000	2,700	1,000	500
22	3,420	940	2,380	2,770	770	770	15,900	5,910	20,300	2,700	1,250	665
23	3,420	850	3,140	2,380	730	770	17,000	5,910	17,700	2,530	1,300	770
24	3,230	850	[illegible]	1,980	690	770	17,400	5,600	13,000	3,400	1,400	600
25	3,000	1,440	[illegible]	1,520	690	770	17,700	4,520	12,700	3,620	1,000	600
26	2,700	1,360	[illegible]	1,480	770	1,570	17,000	5,300	10,900	3,800	1,000	600
27	2,620	2,700	[illegible]	1,570	850	2,700	13,900	5,300	8,640	3,420	1,570	600
28	2,380	2,380	[illegible]	1,400	940	4,100	13,100	5,030	6,140	2,530	1,400	600
29	1,620	1,620	[illegible]	1,400	......	4,600	13,300	4,910	5,400	1,950	1,180	600
30	1,440	1,520	4,270	1,400	......	5,320	12,300	5,330	5,400	1,300	1,000	600
31	1,340	......	[illegible]	1,400	......	[illegible]	......	5,910	......	1,000	1,180	......

NOTE.—Stage-discharge relation affected by ice Jan. 6 to Apr. 5, 1916, and Dec. 14, 1916, to Apr. 7, 1917; discharge determined from gage heights corrected for effect of ice by means of discharge measurements, observer's notes, weather records, and comparison with records of East Branch of Penobscot River at Grindstone. Discharge May 5-10 estimated by comparison with records of flow of near-by streams.

Monthly discharge of Mattawamkeag River at Mattawamkeag, Maine, for the years ending Sept. 30, 1916-17.

[Drainage area, 1,500 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1915-16.					
October	1,470	630	912	0.608	0.70
November	2,310	860	1,390	.927	1.03
December	5,920	1,710	2,960	1.97	2.27
January	7,730	1,090	3,530	2.35	2.71
February	1,140	598	766	.511	.55
March	1,900	780	1,180	.787	.91
April	10,100	2,680	7,120	4.75	5.30
May	5,800	1,820	3,350	2.23	2.57
June	3,230	1,280	2,100	1.40	1.56
July	5,460	1,030	2,330	1.55	1.79
August	1,280	445	775	.517	.60
September	770	390	514	.343	.38
The year	10,100	390	2,250	1.50	20.37
1916-17.					
October	3,420	390	1,320	.880	1.01
November	2,700	690	1,160	.773	.86
December	6,850	1,820	4,470	2.98	3.44
January	3,420	1,340	2,270	1.51	1.74
February	1,400	690	1,060	.707	.74
March	5,910	690	1,390	.927	1.07
April	17,700	7,100	12,400	8.27	9.23
May	11,300	4,810	7,610	5.07	5.84
June	23,300	3,420	9,660	6.44	7.18
July	5,460	1,080	3,060	2.04	2.35
August	2,700	940	1,620	1.08	1.24
September	1,570	500	918	.612	.68
The year	23,300	390	3,910	2.61	35.38

PISCATAQUIS RIVER NEAR FOXCROFT, MAINE.

LOCATION.—At Low's highway bridge, about halfway between Guilford and Foxcroft, Piscataquis County, three-fourths mile above mouth of Black Stream and 3 miles below Mill Stream.

DRAINAGE AREA.—286 square miles.

RECORDS AVAILABLE.—August 17, 1902, to September 30, 1917.

GAGE.—Staff attached to left abutment of bridge; read by A. F. D. Harlow.

DISCHARGE MEASUREMENTS.—At medium and high stages made from bridge; at low stages made by wading either above or below the bridge.

CHANNEL AND CONTROL.—Practically permanent; banks are high and are overflowed only during extreme floods.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.5 feet at 7 a. m., June 18 (discharge, from extension of rating curve, about 19,800 second-feet); minimum stage recorded, 1.7 feet from 5 p. m., September 15, to 7 a. m., Sepber 17 (discharge, 31 second-feet).

ICE.—Stage-discharge relation affected by ice during some winters.

REGULATION.—The stream is used to develop power at several manufacturing plants above the station; distribution of flow somewhat affected by operation of wheels.

ACCURACY.—Stage-discharge relation occasionally affected by backwater from log jams and by ice during winter. Rating curve fairly well defined between 20 and 4,000 second-feet. Gage read to tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Some uncertainty exists in regard to accuracy of gage heights and the effect of diurnal fluctuation. Records fair.

Discharge measurements of Piscataquis River near Foxcroft, Maine, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 2	E. W. Conners	a 3.46	379	Apr. 27	F. E. Pressey	5.06	2,[illegible]
Feb. 5	....do	a 4.00	427	May 14	....do	3.68	[illegible]
Apr. 9	F. E. Pressey	a 6.25	2,680				

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Piscataquis River near Foxcroft, Maine, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	292	100	6,820	502	374	112	3,970	2,640	709	638	2,780	604
2	292	244	3,100	374	374	164	1,960	2,490	502	638	1,840	374
3	148	148	1,720	406	374	180	1,620	2,350	437	604	2,080	406
4	112	148	1,400	502	318	148	1,110	2,220	502	569	1,400	502
5	112	123	1,110	267	437	136	1,160	1,840	502	536	1,110	470
6	112	112	1,110	267	318	81	1,670	1,620	406	470	782	406
7	112	112	1,210	200	267	81	9,040	1,620	346	374	638	315
8	112	220	1,110	100	318	100	8,940	1,840	346	220	638	220
9	136	318	782	220	244	31	6,040	1,840	318	244	604	180
10	112	318	782	220	200	28	3,260	1,210	318	220	898	244
11	112	148	782	220	180	46	2,350	1,210	2,080	164	1,840	180
12	112	64	674	292	148	58	1,840	1,300	7,010	200	1,210	180
13	112	112	604	374	374	100	1,840	1,110	3,970	267	1,020	148
14	180	112	604	292	374	64	1,840	898	1,840	318	709	123
15	318	180	604	858	292	100	1,840	782	2,080	374	709	51
16	220	136	638	1,400	292	100	1,840	782	2,490	292	638	31
17	136	100	604	1,210	292	81	1,620	782	4,340	220	604	46
18	112	100	569	898	220	81	2,350	782	17,500	220	674	81
19	100	100	569	674	220	81	2,350	709	8,220	220	638	90
20	709	136	569	502	220	81	2,220	638	3,260	180	638	112
21	1,110	180	437	267	220	81	3,970	709	2,350	180	638	112
22	898	244	569	437	180	81	4,700	858	1,840	220	604	100
23	569	148	1,020	374	200	90	6,620	980	1,400	180	604	81
24	502	244	1,620	374	200	100	5,840	1,960	1,200	180	858	164
25	406	1,160	1,510	318	200	267	4,150	1,400	1,160	180	1,620	244
26	406	1,110	1,160	318	200	638	3,260	1,160	858	180	1,070	164
27	318	437	638	244	180	709	3,100	746	536	81	638	148
28	346	374	502	100	180	2,640	2,080	638	502	81	638	136
29	267	374	502	220	....	7,210	2,080	536	569	64	709	112
30	100	782	502	220	....	4,980	2,350	938	820	437	746	90
31	100	....	638	220	....	4,150	....	980	....	7,810	604	....

NOTE.—Stage-discharge relation affected by ice Dec. 13 to Apr. 9; discharge ascertained from gage heights, three discharge measurements, observer's notes, weather records, and comparisons with other streams.

Monthly discharge of Piscataquis River near Foxcroft, Maine, for the year ending Sept. 30, 1917.

[Drainage area, 286 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,110	100	280	0.979	1.13
November	1,160	64	269	.941	1.05
December	6,820	437	1,110	3.88	4.47
January	1,400	100	415	1.45	1.67
February	437	148	264	.923	.96
March	7,210	28	735	2.57	2.96
April	9,040	1,110	3,230	11.30	12.61
May	2,640	536	1,280	4.48	5.16
June	17,500	318	2,280	7.98	8.90
July	7,810	64	534	1.87	2.16
August	2,780	604	974	3.40	3.92
September	604	31	204	.713	.80
The year	17,500	28	965	3.37	45.79

PASSADUMKEAG RIVER AT LOWELL, MAINE.

LOCATION.—About half a mile below dam and highway bridge at Lowell, Penobscot County, and 10 miles above mouth of river.

DRAINAGE AREA.—301 square miles.

RECORDS AVAILABLE.—October 1, 1915, to September 30, 1917.

GAGES.—Chain and staff gages on right bank; read by F. A. Lord. Staff above dam, half a mile upstream, for supplementary use during winter.

DISCHARGE MEASUREMENTS.—Made from cable 20 feet above gage.

CHANNEL AND CONTROL.—Channel rough and somewhat irregular; control about 500 feet below gage; practically permanent. Left bank subject to overflow at gage height 5.5 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.8 feet at 9.30 a. m. April 26 (discharge 2,460 second-feet); minimum open-water stage recorded during year, 1.3 feet at 9 a. m. November 13 (discharge 134 second-feet); minimum discharge, 120 second-feet, November 18–23 (stage-discharge relation affected by ice).

ICE.—Stage-discharge relation usually affected by ice from December to April.

REGULATION.—Distribution of flow somewhat affected by use of storage reservoirs above station. A small dam and mill one-half mile above gage causes fluctuations in stage for a short time each day when mill is in operation.

ACCURACY.—Stage-discharge relation practically permanent, except when affected by backwater due to logs on control or to ice. Rating curve well defined between 70 and 2,600 second-feet. Gage read to tenths once daily until April 18, and to half tenths thereafter. Daily discharge ascertained by applying daily gage height to rating table. Records fair.

COOPERATION.—Discharge measurements made and discharge computed by T. W. Clark, hydraulic engineer, Oldtown, Me.

Discharge measurements of Passadumkeag River at Lowell, Maine, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 5	H. A. Lancaster	1.61	200	Mar. 28	H. A. Lancaster	2.99	704
Nov. 17	.....do	a 1.39	119	29	.....do	a 3.62	968
Dec. 22	.....do	a 2.28	274	Apr. 7	.....do	4.16	1,310
22	.....do	a 2.17	281	19	.....do	4.80	1,780
Jan. 8	E. W. Conners	a 2.59	357	25	.....do	5.70	2,370
8	.....do	a 2.60	367	May 21	.....do	4.02	1,250
Feb. 13	H. A. Lancaster	a 4.70	237	June 19	.....do	4.97	1,080
14	.....do	a 4.60	237	Aug. 6	.....do	2.58	485
				29	.....do	1.83	283

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Passadumkeag River at Lowell, Maine, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	226	340	480	320	270	240	1,000	1,500	1,110	1,170	632	281
2	253	281	606	320	270	240	1,000	1,740	1,230	1,230	584	240
3	226	253	700	320	270	240	1,000	1,560	1,290	1,170	606	253
4	226	310	700	320	240	240	1,060	1,530	1,290	1,350	584	253
5	253	253	700	320	240	240	1,110	1,410	1,290	1,350	562	226
6	226	226	900	320	240	210	1,170	1,440	1,230	1,230	520	267
7	200	200	900	360	240	210	1,350	1,410	1,200	1,110	480	279
8	200	176	850	360	240	210	1,530	1,410	1,170	1,230	442	267
9	226	176	800	390	240	240	1,530	1,320	1,140	1,140	406	226
10	200	154	750	390	240	240	1,470	1,380	1,050	1,110	406	253
11	176	154	700	360	240	240	1,410	1,470	1,080	1,080	424	253
12	176	154	606	360	240	240	1,290	1,530	1,260	1,140	442	240
13	226	134	520	360	240	240	1,350	1,560	1,380	1,170	442	226
14	226	134	440	390	240	240	1,530	1,560	1,380	1,050	461	253
15	226	134	410	420	210	240	1,470	1,530	1,290	1,080	442	281
16	226	134	340	460	210	240	1,470	1,530	1,140	1,020	406	269
17	253	130	310	500	210	240	1,530	1,470	1,170	1,000	356	281
18	253	120	310	500	210	240	1,650	1,260	1,710	950	340	281
19	253	120	310	460	210	240	1,780	1,200	1,820	900	310	253
20	310	120	280	420	210	240	1,920	1,170	1,850	900	310	226
21	340	120	280	390	210	240	2,140	1,260	1,880	850	356	226
22	406	120	280	360	210	240	2,300	1,230	1,820	800	356	253
23	442	120	320	320	210	240	2,380	1,050	1,680	780	310	240
24	406	154	390	320	210	260	2,420	1,000	1,500	800	267	253
25	406	226	460	320	210	300	2,380	1,170	1,440	700	253	240
26	406	281	460	320	210	320	2,460	1,080	1,440	652	253	200
27	340	310	460	290	210	360	2,220	1,050	1,260	629	267	200
28	406	310	460	290	240	700	2,020	1,050	1,170	606	267	189
29	406	281	420	290	....	950	1,920	1,110	1,110	584	267	189
30	406	310	390	290	....	1,050	1,650	1,110	1,170	541	296	176
31	406	....	360	290	....	1,050	....	1,170	....	520	296	....

NOTE.—Stage-discharge relation affected by ice Nov. 17-23, and Dec. 13 to Mar. 30; discharge determined from gage-height records and discharge measurements. Daily discharge on May 18, 28, July 25, Aug. 21, and Sept. 11, corrected for opening of gates in dam. Discharge estimated Oct. 10, Apr. 1, and Sept. 7, 16, and 26-29.

Monthly discharge of Passadumkeag River at Lowell, Maine, for the year ending Sept. 30, 1917.

[Drainage area, 301 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	406	176	288	0.957	1.10
November	340	120	198	.658	.73
December	900	280	513	1.70	1.96
January	500	290	359	1.19	1.37
February	270	210	229	.761	.79
March	1,050	210	336	1.12	1.29
April	2,460	1,000	1,650	5.48	6.11
May	1,740	1,000	1,330	4.42	5.10
June	1,880	1,050	1,350	4.49	5.01
July	1,350	520	963	3.20	3.69
August	652	253	399	1.33	1.53
September	281	176	242	.804	.90
The year	2,460	120	656	2.18	29.58

KENDUSKEAG STREAM NEAR BANGOR, MAINE.

Location.—At highway bridge at Sixmile Falls, 6 miles northwest of Bangor, Penobscot County, and 7 miles below mouth of Black Stream.

Drainage area.—191 square miles. At high stages a part of the water of Souadabscook Stream finds its way through an artificial cut into Black Stream and thus to the Kenduskeag.

Records available.—September 15, 1908, to September 30, 1917.

Gage.—Chain attached to bridge; read by Fred Cort.

Discharge measurements.—Made from the bridge.

Channel and control.—Practically permanent; channel broken by one pier at the bridge.

Extremes of discharge.—Maximum open-water stage recorded during year, 9.5 feet at 7 a. m. and 4 p. m. April 8 (discharge from extension of rating curve, 4,950 second-feet); maximum stage of 11.2 feet occurred Mar. 29 when stage-discharge relation was affected by ice; minimum stage recorded, 2.0 feet at 7.20 a. m. and 2.00 p. m. September 30 (discharge 52 second-feet).

Ice.—Stage-discharge relation seriously affected by ice for several months.

Diversions.—An artificial cut was made for log driving through a low divide between Souadabscook Stream and Black Stream, which enters the Kenduskeag about 7 miles above the gaging station. During high stages of the Souadabscook, part of its water flows through the artificial cut into the Kenduskeag. Black Stream probably sends its water only to the Kenduskeag.

Accuracy.—Stage-discharge relation fairly permanent except as affected by ice; shifts slightly at infrequent intervals. Rating curve well defined below 2,600 second-feet and fairly well defined between 2,600 and 4,000 second-feet. Gage read to tenths twice daily during open-water period; read twice a week during the winter. Daily discharge ascertained by applying rating table to mean daily gage height. Records good for ordinary stages; for winter records, fair.

Discharge measurements of Kenduskeag Stream near Bangor, Maine, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec-ft.*			*Feet.*	*Sec-ft.*
Dec. 27	E. W. Conners	[a] 6.08	514	May 16	F. E. Pressey	3.08	290
Jan. 30	.....do	[a] 3.48	137	June 6	.....do	2.78	201
Feb. 17	.....do	[a] 3.16	89	June 13	G. C. Danforth	7.96	3,570
Apr. 4	G. C. Danforth	5.92	1,680				

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Kenduskeag Stream near Bangor, Maine, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
23	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
26	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	115	[illegible]	[illegible]
28	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	115	[illegible]	[illegible]
29	[illegible]	[illegible]	[illegible]	[illegible]	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30	[illegible]	[illegible]	[illegible]	[illegible]	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
31	[illegible]	......	[illegible]	[illegible]	......	[illegible]	......	[illegible]	......	[illegible]	[illegible]	......

Note.—Stage-discharge relation affected by ice Dec. 19 to Mar. 30; discharge determined from gage heights, three discharge measurements, observer's notes, and weather records.

Monthly discharge of Kenduskeag Stream near Bangor, Maine, for the year ending Sept. 30, 1917.

[Drainage area, 191 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	655	[illegible]	178	0.932	[illegible]
November	[illegible]	[illegible]	[illegible]	1.00	1.12
December	[illegible]	[illegible]	[illegible]	4.65	[illegible]
January	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
February	156	71	119	.623	.65
March	4,950	129	751	3.96	4.59
April	[illegible]	[illegible]	1,940	[illegible]	[illegible]
May	655	[illegible]	[illegible]	2.09	[illegible]
June	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
July	[illegible]	99	313	1.64	[illegible]
August	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
September	[illegible]	62	145	.759	.85
The year	[illegible]	61	[illegible]	[illegible]	41.70

KENNEBEC RIVER BASIN.

MOOSEHEAD LAKE AT EAST OUTLET, MAINE.

LOCATION.—At wharf at east outlet of lake, about 8 miles from Kineo, Piscataquis County.

DRAINAGE AREA.—1,240 square miles.

RECORDS AVAILABLE.—April 1, 1895, to September 30, 1917.

GAGE.—Staff at end of boat landing; two datums have been used at east outlet; the first (or original datum) is 1,011.30 feet above mean sea level and approximately 10 feet below sills of outlet gates; gage is read to this datum; the second, to which all gage readings published to and including 1911 have been referred, is 10 feet higher; that is, the zero is at the sill of the gates; as it is believed that low water may go below the sill of the gates (zero of second datum), gage heights since 1912 are published as read—that is, to original datum.

REGULATION.—The lake is regulated to a capacity of 23,735,000,000 cubic feet. The dam at the east outlet is controlled by 39 gates; the sills of the gates being at elevations varying from 8.0 feet to 11.4 feet (original datum). At extreme low stages the flow from the lake is controlled not by the gates but by a bar above the dam at an approximate gage height of 9 feet (original datum). The records show only fluctuations in the level of the lake and are used in the studies of regulation of the lake and in computing the natural flow of the Kennebec at The Forks station.

COOPERATION.—Record furnished by Hollingsworth & Whitney Co.

Daily gage height, in feet, of Moosehead Lake at east outlet, Maine, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		15.1		15.55					17.4		16.4	
2	15.45		14.7			13.55		16.5		17.4		
3		15.1		15.55	14.95						16.9	17.35
4	15.45		14.9				12.5	16.2	17.4		17.1	
5				15.5	14.85						17.25	
6	15.35	15.1	14.95			13.45			17.45	17.3	17.3	17.35
7					14.7		12.7	16.4			17.4	17.2
8		15.05		15.45		13.3			17.4		17.4	
9	15.4		15.3		14.65		12.9	16.55		17.15	17.35	
10		14.9		15.45							17.45	
11								16.7		17.0	17.45	
12	15.1		15.4	15.4	14.4		13.1		17.55			16.8
13	15.0	14.9					13.2		17.55			
14			15.4			12.0		17.1		16.8	17.35	16.7
15		14.8	15.5	15.4	14.3				17.5		17.4	
16	14.95	14.8			14.25	12.95	13.5	17.4				
17				15.4						16.4	17.4	16.6
18	14.9		15.6				13.6	17.5	17.7	16.3		
19			15.5		14.15							
20	14.95	14.7		15.4			13.9		17.8	16.2	17.4	16.3
21					13.95	12.6		17.45				16.2
22		14.6	15.6	15.4			14.2		17.6			
23	15.05							17.5		16.1	17.45	
24		14.55		15.4	13.8							16.0
25	15.0		15.5				14.8	17.45	17.3	16.2	17.5	
26				15.4								15.9
27	15.1	14.5	15.5		13.7		15.3		17.4	16.1	17.45	
28					13.65	12.3		17.35				15.7
29		14.55		15.4					17.4		17.4	
30	15.0		15.5				15.75	17.4		16.0		
31				15.2							17.7	

KENNEBEC RIVER AT THE FORKS, MAINE.

Location.—At wooden highway bridge about 1,000 feet above mouth of Dead River at The Forks, Somerset County.

Drainage area.—[illegible] square miles.

Records available.—September 28, 1901, to September 30, 1917.

Gages.—Chain gage, to which a vertical staff on concrete retaining wall on left bank [illegible] feet above bridge, and a Barrett 7-day water-stage recorder in [illegible] adjustment; recorder set to read the same as chain gage at low water, but gives lower readings than chain gage at high water; used during summer months only. Chain gage read by [illegible].

Discharge measurements.—Made from the bridge.

Channel and control.—Channel at bridge is subject to slight changes; control is occasionally affected by backwater from Dead River.

Extremes of discharge.—Maximum stage recorded during year, [illegible] feet, from [illegible] p. m. June [illegible] (discharge, by extension of rating curve, [illegible] second-feet); minimum stage recorded during year, [illegible] feet on October 24 (discharge, [illegible] second-feet).

Ice.—Stage-discharge relation seriously affected by ice for several months.

Regulation.—Flow regulated by storage in Moosehead Lake. During May, June, July, and August the operation of Indian Pond for log driving causes a large diurnal fluctuation. Records of monthly discharge have been reduced to natural flow by adding or subtracting the amount of water stored in or released from Moosehead Lake.

Accuracy.—Stage-discharge relation occasionally affected by backwater from Dead River and by ice during the winter. Rating curve fairly well defined, a table of relation being used to convert discharge rating for chain gage to a corresponding rating for water-stage recorder. Water-stage recorder in operation October 1 to November 15 and April 26 to September 30; chain gage read to half-tenths once daily November 16 to April 25. Daily discharge for period when water-stage recorder was in operation determined by use of discharge integrator; for period when water-stage recorder was not in operation, discharge ascertained by applying rating table to mean daily gage height. Records fair.

Discharge measurements of Kennebec River at The Forks, Maine, during the year ending September 30, 1917.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		Feet.	Sec.-ft.			Feet.	Sec.-ft.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	do.	[illegible]	[illegible]	[illegible]	do.	[illegible]	[illegible]

a Stage-discharge relation affected by ice. b Stage-discharge relation affected by log jam.

Daily discharge, in second-feet, of Kennebec River at The Forks, Maine, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,320	1,700	1,740	2,100	3,000	1,950	1,160	4,500	5,000	9,200	7,400	3,900
2	1,200	1,720	1,740	2,100	3,000	2,200	990	4,700	4,700	8,800	3,100	3,800
3	1,180	1,620	1,530	2,100	3,200	2,100	915	5,400	4,500	7,700	2,600	3,750
4	1,280	1,560	1,240	2,300	3,200	2,100	915	5,200	4,550	6,300	3,300	3,750
5	1,160	1,380	1,070	2,200	3,200	2,100	840	5,500	4,700	6,000	2,600	3,400
6	1,220	1,400	990	1,950	3,000	2,200	915	4,100	6,000	7,300	2,100	3,200
7	2,100	1,440	990	1,950	3,000	2,500	1,330	4,100	5,200	6,900	3,050	3,850
8	2,350	1,540	990	1,850	3,000	2,600	1,630	4,600	3,600	6,800	6,100	3,850
9	2,300	1,540	990	1,850	2,900	2,700	1,740	4,050	5,900	6,800	6,000	4,400
10	1,980	1,380	990	1,950	2,800	2,600	1,740	4,850	8,300	6,600	7,400	4,200
11	1,920	1,680	920	1,850	2,700	2,600	1,740	5,200	10,600	6,300	9,800	4,600
12	1,900	1,740	920	1,850	2,600	2,600	1,330	3,800	14,700	6,200	9,200	4,300
13	1,920	1,660	840	1,850	2,600	2,700	1,330	3,200	14,200	6,200	7,300	4,100
14	1,940	1,700	1,350	1,950	2,600	2,600	1,240	3,850	13,300	5,800	5,500	4,150
15	1,740	1,740	1,450	1,850	2,700	2,500	1,150	3,000	12,600	6,200	4,650	4,350
16	1,700	1,850	1,750	820	2,600	2,600	1,100	2,400	12,300	6,000	4,550	4,300
17	1,680	1,960	1,950	920	2,600	2,500	1,240	5,000	13,100	5,900	4,850	4,200
18	1,760	1,850	2,100	1,650	2,500	2,500	1,740	7,700	17,600	5,800	3,900	5,200
19	1,900	1,740	2,200	1,850	2,500	2,500	1,960	7,500	18,000	5,900	3,750	4,300
20	2,100	1,740	2,200	1,850	2,500	2,460	2,460	7,500	17,000	5,900	4,300	3,900
21	1,500	1,740	2,200	1,850	2,500	2,600	2,880	5,300	16,600	5,700	4,300	3,450
22	1,000	1,850	2,100	1,850	2,500	2,740	3,810	5,800	16,000	5,600	4,200	3,300
23	740	1,740	2,100	1,850	2,300	2,600	4,880	6,800	15,400	4,400	3,950	3,300
24	710	1,850	2,100	2,100	2,100	2,450	5,460	7,500	15,000	4,100	4,000	3,300
25	850	1,960	1,950	2,300	2,100	2,600	3,640	7,400	13,000	3,700	4,350	3,250
26	920	1,960	1,850	2,600	2,100	2,600	3,320	7,200	8,300	3,750	4,350	3,200
27	920	1,740	1,850	2,700	2,100	2,600	3,260	6,800	6,500	3,700	4,100	3,150
28	1,120	1,530	1,850	2,900	1,950	2,880	2,850	5,000	7,200	4,000	4,100	3,050
29	1,400	1,430	1,950	2,900	....	2,080	2,700	4,200	8,000	3,400	4,000	3,000
30	1,500	1,330	2,100	3,000	....	1,960	3,200	5,000	9,400	4,100	4,150	3,000
31	1,540	....	2,100	3,000	....	1,850	....	5,300	....	11,000	4,000	....

NOTE.—Stage-discharge relation affected by ice Dec. 10 to Mar. 19; discharge ascertained from gage heights, two discharge measurements, observer's notes, and weather records; affected by logs Apr. 15–16.

Monthly discharge of Kennebec River at The Forks, Maine, for the year ending Sept. 30, 1917.

[Drainage area, 1,570 square miles.]

Month.	Discharge in second-feet.			Corrected run-off (depth in inches on drainage area).
	Observed mean.	Corrected for storage.		
		Mean.	Per square mile.	
October	1,510	1,030	0.656	0.76
November	1,700	1,210	.771	.86
December	1,620	2,690	1.71	1.97
January	2,060	1,700	1.08	1.24
February	2,640	610	.389	.42
March	2,440	970	.618	.71
April	2,120	6,220	3.96	4.42
May	5,240	7,220	4.60	5.30
June	10,400	10,400	6.62	7.39
July	6,000	4,560	2.90	3.34
August	4,740	6,540	4.17	4.81
September	3,780	1,240	.790	.88
The year	3,680	3,700	2.36	32.10

DEAD RIVER AT THE FORKS, MAINE.

LOCATION.—One-eighth mile above farm house of Jeremiah Durgin, 1½ miles west of The Forks, Somerset County.

DRAINAGE AREA.—878 square miles.

RECORDS AVAILABLE.—September 29, 1901, to August 15, 1907; March 16, 1910, to September 30, 1917.

GAGE.—Scale bolted to large boulder on left bank; read by H. J. Farley.

DISCHARGE MEASUREMENTS.—Made from cable 700 feet above gage.

CHANNEL AND CONTROL.—Stream bed rough; control practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage during year, about 7.9 feet on morning of June 21; discharge about 22,900 second-feet; minimum open-water stage recorded during year, 0.5 foot, several times in October and November; discharge, from extension of rating curve, 100 second-feet.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—A number of dams on lakes above; used for log driving during May and June.

ACCURACY.—Stage-discharge relation practically permanent except when affected by ice or log jams. Rating curve fairly well defined. Gage read to half-tenths twice daily, except during winter when it is read twice a day, three times a week. Daily discharge determined by applying mean daily gage height to rating curve. Open-water record good; winter record fair.

Discharge measurements of Dead River at The Forks, Maine, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 25	E. W. Conners	a 2.7[illegible]	4[illegible]	Apr. 25	F. E. Pressey	4.40	7,250
Feb. 23	....do	a [illegible]	[illegible]	May 28	....do	5.14	10,500
Apr. 27	F. E. Pressey	2.28	[illegible]				

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Dead River at The Forks, Maine, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	325	3,050	4,710	3,580	1,790	5,280	1,300
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3,150	5,240	3,580	1,940	4,970	1,290
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3,250	6,140	3,900	2,300	4,400	1,100
4	224	[illegible]	[illegible]	[illegible]	466	415	3,356	2,750	3,140	2,080	3,900	902
5	246	[illegible]	[illegible]	[illegible]	466	415	3,550	4,400	3,770	1,330	3,550	665
6	[illegible]	[illegible]	[illegible]	[illegible]	490	425	3,650	4,220	3,900	840	1,800	610
7	[illegible]	[illegible]	[illegible]	[illegible]	490	460	3,770	4,400	4,970	560	1,240	720
8	[illegible]	[illegible]	[illegible]	[illegible]	490	460	3,340	3,550	4,970	610	1,030	540
9	[illegible]	[illegible]	[illegible]	425	425	510	3,140	3,900	2,940	610	1,320	510
10	[illegible]	[illegible]	[illegible]	325	425	510	2,750	3,900	2,470	665	1,540	510
11	[illegible]	[illegible]	[illegible]	240	425	510	2,500	3,900	4,400	720	1,700	580
12	[illegible]	[illegible]	[illegible]	160	425	460	2,380	3,900	8,940	840	1,320	530
13	[illegible]	[illegible]	[illegible]	130	415	400	2,120	3,340	10,500	780	1,100	480
14	[illegible]	[illegible]	[illegible]	425	[illegible]	415	1,960	7,130	8,570	720	1,170	400
15	[illegible]	200	[illegible]	615	370	415	1,940	3,550	6,780	780	2,120	340
16	[illegible]	140	510	720	325	415	2,080	3,550	5,240	665	2,380	300
17	[illegible]	[illegible]	[illegible]	780	[illegible]	460	2,030	4,970	4,400	610	2,290	340
18	[illegible]	[illegible]	[illegible]	780	325	510	2,560	5,530	13,800	560	2,200	400
19	[illegible]	[illegible]	[illegible]	720	325	610	3,140	3,340	8,940	610	2,290	450
20	540	[illegible]	510	720	325	610	3,550	6,140	8,940	510	2,470	600
21	1,[illegible]	100	510	720	325	610	3,990	3,140	17,800	510	2,080	700
22	1,540	[illegible]	560	720	325	660	4,220	4,710	10,500	510	1,940	660
23	1,[illegible]	[illegible]	1,540	660	325	720	7,490	3,550	4,970	510	1,900	600
24	[illegible]	325	1,240	720	325	720	10,500	3,140	3,340	610	1,940	550
25	610	540	540	660	325	1,240	8,940	3,140	3,580	560	2,200	600
26	610	1,100	720	610	325	1,940	8,940	3,140	2,750	510	2,030	640
27	510	1,130	720	610	325	2,200	6,570	3,550	2,080	510	1,880	500
28	397	1,130	660	610	325	2,550	4,400	3,140	1,700	510	1,790	440
29	240	965	610	560	....	3,250	4,970	3,140	1,940	415	1,400	400
30	176	1,330	610	560	....	3,150	4,970	3,980	1,880	510	1,320	380
31	160	....	610	510	....	3,050	....	3,980	....	14,000	1,400	....

NOTE.—Stage-discharge relation affected by ice Dec. 26 to Apr. 4; discharge determined from a study of observed gage heights, two discharge measurements, temperature records, and hydrograph comparison with East Branch of Penobscot River at Grindstone; affected by log jams Sept. 11–30, and discharge determined by comparisons with near-by streams. Discharge estimated Apr. 5–6, and also June 18, 21, and July 31, when water was over the gage.

Monthly discharge of Dead River at The Forks, Maine, for the year ending Sept. 30, 1917.

[Drainage area, 878 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,620	100	406	0.463	0.53
November	1,390	100	356	.405	.45
December	3,550	510	1,080	1.23	1.42
January	780	100	560	.638	.74
February	510	325	389	.443	.46
March	3,250	325	941	1.07	1.23
April	10,500	1,860	4,140	4.72	5.27
May	7,130	2,750	4,120	4.69	5.41
June	17,800	1,700	5,610	6.39	7.13
July	14,600	415	1,260	1.44	1.66
August	8,200	1,030	2,290	2.61	3.01
September	1,390	300	606	.690	.77
The year	17,800	100	1,820	2.07	28.08

SEBASTICOOK RIVER AT PITTSFIELD, MAINE.

Location.—At steel highway bridge just above Maine Central Railroad bridge in Pittsfield, Somerset County.

Drainage area.—320 square miles.

Records available.—July 27, 1908, to September 30, 1917.

Gage.—Chain attached to highway bridge; read by C. D. Morrill.

Discharge measurements.—Made from the highway bridge.

Channel and control.—Practically permanent; banks high and rocky and not subject to overflow.

Extremes of discharge.—Maximum stage recorded during year, 7.7 feet at 6.20 a. m. June 19 (discharge, 5,590 second-feet); minimum stage recorded during year, 2.7 feet at 6 a. m. October 10 and 9 a. m. and 6 p. m. October 15 (discharge, 148 second-feet).

Ice.—Stage-discharge relation not seriously affected by ice, as the rapid fall and the proximity of the power plant immediately above station tend to keep river open.

Regulation.—About 800 feet upstream from the station is the dam of the American Woolen Co. (Pioneer Mills) and the Smith Textile Co.; and about half a mile farther upstream is the dam of the American Woolen Co.'s Waverly Mill; the storage of water at these dams causes diurnal fluctuation at the gage.

Accuracy.—Stage-discharge relation shifts occasionally. Rating curve fairly well defined. Gage read to tenths twice daily. Owing to lack of exact information in regard to the stage at night when mills are shut down, figures for daily discharge are not published.

The following discharge measurement was made by F. E. Pressey:

May 15, 1917: Gage height, 3.70 feet; discharge, 602 second-feet.

Twice-daily discharge, in second-feet, of [illegible] River at Pittsfield, Maine, for the year ending Sept. 30, [illegible].

Day	Oct. A.M.	Oct. P.M.	Nov. A.M.	Nov. P.M.	Dec. A.M.	Dec. P.M.	Jan. A.M.	Jan. P.M.	Feb. A.M.	Feb. P.M.	Mar. A.M.	Mar. P.M.
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
23	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
26	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
28	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
29	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]	[illegible]
30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]	[illegible]
31	[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]			[illegible]	1,730

Day	Apr. A.M.	Apr. P.M.	May A.M.	May P.M.	June A.M.	June P.M.	July A.M.	July P.M.	Aug. A.M.	Aug. P.M.	Sept. A.M.	Sept. P.M.
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	475	475
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	475	475
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	475	475
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	732	[illegible]	475
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	732	915	475	424
11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	732	475	424
12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	732	732	424	424
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	732	732	424	424
14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	732	331	376
15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	331	376	376
16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	475	475	280	331
17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	530	530	280	280
18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	475	475	331	331
19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	475	475	331	331
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	475	530	331	376
21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	331	530	530	376	331
22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	475	475	331	280
23	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	475	475	280	280
24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	580	580	331	376
25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	331	[illegible]	815	331	376
26	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1,100	1,100	331	376
27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	331	1,000	1,000	376	376
28	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	906	906	376	376
29	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	915	915	331	280
30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	424	915	915	280	280
31			[illegible]	[illegible]			[illegible]	[illegible]	732	732		

ANDROSCOGGIN RIVER BASIN.

ANDROSCOGGIN RIVER AT ERROL DAM, N. H.

Location.—At Errol dam, 1 mile above Errol, Coos County.

Drainage area.—1,095 square miles.

Records available.—January 1, 1905, to September 30, 1917.

Gage.—Movable rod gage; readings taken daily from sill of deep gate No. 6; elevation of zero of gage or sill of gate, 1,231.3 feet above mean sea level.

Discharge.—Computed from discharge through 14 gates in the dam by means of coefficients determined from a few discharge measurements.[1]

Ice.—Stage-discharge relation little affected by ice.

Regulation.—Errol dam regulates the storage of Umbagog Lake, the lower of the Rangeley series of lakes, comprising the principal storage of Androscoggin River and amounting to nearly 20 billion cubic feet, and also a recently developed storage site on Magalloway River created by the Aziscohos Dam, which amounts to about 9.6 billion cubic feet, thus making the total storage about 29.6 billion cubic feet. Errol dam is about 5 miles below outlet of Umbagog Lake and about 3.5 miles below mouth of Magalloway River, thus making this stream one of the feeders of Umbagog Lake. Results not corrected for storage.

Cooperation.—Records obtained and computations of daily discharge made under direction of Walter H. Sawyer, agent for Union Water Power Co., Lewiston, Me.

Daily discharge, in second-feet, of Androscoggin River at Errol dam, N. H., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,670	1,630	1,060	1,820	2,110	2,400	1,550	1,940	2,160	4,600	2,520	1,630
2	1,740	1,590	1,080	1,850	2,150	2,460	1,610	1,960	2,160	3,860	2,480	1,750
3	1,720	1,640	1,090	1,880	2,150	2,450	1,770	1,980	2,180	3,550	2,480	1,950
4	1,720	1,640	1,300	1,860	2,130	2,490	1,690	1,970	2,190	3,100	2,500	1,930
5	1,760	1,640	1,440	1,850	2,130	2,540	1,640	1,970	2,410	2,220	2,490	1,890
6	1,790	1,640	1,430	1,830	2,140	2,550	1,590	1,940	2,670	2,460	2,540	1,860
7	1,880	1,640	1,430	1,820	2,150	2,490	1,550	1,920	3,280	2,040	2,460	1,800
8	1,930	1,760	1,420	1,870	2,100	2,500	1,500	1,910	4,540	2,390	2,420	1,780
9	1,950	1,810	1,510	2,010	2,020	2,500	1,470	1,900	4,980	2,230	2,310	1,830
10	1,940	1,780	1,540	1,970	2,020	2,440	1,840	1,730	4,890	2,030	2,060	1,870
11	1,870	1,760	1,510	1,970	2,040	2,440	1,830	1,200	4,800	1,560	2,270	1,900
12	1,850	1,870	1,500	2,010	2,030	2,460	1,660	930	5,360	1,760	2,360	1,940
13	1,770	1,810	1,570	2,030	2,040	2,480	1,570	951	7,170	2,160	2,320	1,940
14	1,640	1,760	1,620	1,880	2,050	2,480	1,530	941	9,060	2,190	2,380	1,980
15	1,680	1,820	1,580	1,830	2,040	2,430	1,380	1,670	9,880	2,350	2,310	2,010
16	1,790	1,930	1,470	1,810	2,050	2,140	1,330	1,850	9,360	2,370	2,190	1,940
17	1,760	1,960	1,630	1,810	2,060	2,080	1,330	1,850	9,270	2,340	1,710	1,930
18	1,800	1,930	1,700	1,800	2,110	2,090	1,330	1,850	9,630	2,300	1,500	1,930
19	1,740	1,790	1,730	1,840	2,200	2,060	1,310	1,870	10,600	2,390	2,080	1,900
20	1,110	1,750	1,780	1,900	2,350	2,060	1,110	1,880	11,900	2,400	1,780	1,880
21	1,000	1,810	1,800	1,970	2,380	2,070	844	1,910	12,500	2,310	1,550	1,680
22	1,140	1,820	1,800	1,990	2,470	2,040	939	1,940	12,300	2,240	1,430	1,660
23	1,450	1,720	1,800	1,990	2,490	2,220	1,110	2,490	11,900	2,200	1,410	1,700
24	1,620	1,210	1,800	1,950	2,510	2,250	1,440	2,860	11,500	2,240	1,380	1,830
25	1,630	1,430	1,810	1,940	2,520	2,230	1,760	2,780	10,600	2,360	1,280	1,860
26	1,640	1,560	1,810	1,970	2,530	2,200	1,790	2,640	9,190	2,600	1,280	1,770
27	1,640	1,690	1,810	2,060	2,460	1,890	1,820	2,340	8,190	2,720	1,330	1,830
28	1,640	1,600	1,690	2,100	2,410	1,630	1,820	2,290	7,030	2,580	1,540	1,840
29	1,640	1,300	1,710	2,130	....	1,520	1,830	2,280	6,430	2,520	1,670	1,820
30	1,530	987	1,760	2,150	....	1,680	1,870	2,230	5,730	2,580	1,700	1,850
31	1,620	....	1,820	2,120	....	1,630	....	2,160	....	2,560	1,690	......

[1] See U. S. Geol. Survey Water Supply Paper 321, p. 61.

Monthly discharge of Androscoggin River at Errol dam, N. H., for the year ending Sept. 30, 1917.

[Drainage area, [illegible] square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
November	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
December	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
January	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
February	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
March	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
April	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
June	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
July	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
August	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
September	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
The year	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

NOTE.—The monthly discharge in second-feet per square mile and the run-off in depth in inches do not represent the natural flow from the basin because of artificial storage.

ANDROSCOGGIN RIVER AT BERLIN, N. H.

LOCATION.—At upper or sawmill dam of Berlin Mills Co., at Berlin, Coos County.

DRAINAGE AREA.—[illegible] square miles.

RECORDS AVAILABLE.—October 1, [illegible], to September 30, 1917.

GAGES.—Fixed gages are maintained in the river above the forebay racks and in the tailrace immediately below the outlet of the wheels. These gages are referred to the same datum, and the differences in the readings give the head acting on the wheels. A gage is also attached to each wheel gate, from which the wheel-gate opening can be ascertained.

DETERMINATION OF DISCHARGE.—Discharge computed from curves prepared from Holyoke tests of the wheel runners, using the head and gate openings as ascertained from the gages. Quantity of water wasted over the dam is computed by the Francis formula for discharge over weirs.

ICE.—Stage-discharge relation not affected by ice.

REGULATION.—Under an agreement between the power users on Androscoggin River, the flow at Berlin, N. H., is maintained at a minimum of [illegible] second-feet and at such a point above [illegible] second-feet as is consistent with the constant maintenance of that quantity. Final regulation of the river is made at Pontook dam, N. H., above which is a pond containing about a day's supply; the primary regulation is made at Errol, N. H., about 30 miles above Berlin.

COOPERATION.—Gages are under the direction of George P. Abbott, of the Berlin Mills Co., and discharge record is furnished for publication by Walter H. Sawyer, agent for Union Water Power Co., Lewiston, Maine.

Daily discharge, in second-feet, of Androscoggin River at Berlin, N. H., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,600	1,950	3,500	1,980	2,150	2,450	2,400	4,650	3,650	10,600	1,800	2,200
2	2,400	1,970	3,100	2,050	2,150	2,450	2,200	4,600	3,800	7,600	1,900	2,200
3	1,950	1,980	2,700	2,000	2,150	2,500	2,500	4,300	3,800	6,700	1,900	2,200
4	2,150	1,970	2,070	2,000	2,150	2,500	2,650	4,100	3,900	6,000	1,900	2,200
5	1,940	2,050	2,100	2,000	2,150	2,500	2,600	4,100	3,900	4,200	1,800	2,000
6	1,940	1,980	2,220	1,990	2,150	2,500	2,650	4,000	3,600	3,000	1,800	1,900
7	1,940	1,930	2,250	1,980	2,150	2,500	2,750	3,800	3,650	3,000	1,800	2,000
8	1,950	1,940	2,160	1,980	2,150	2,500	2,750	3,600	4,300	1,850	1,800	1,700
9	2,000	1,960	2,080	1,990	2,150	2,500	2,700	3,800	5,800	2,700	1,800	2,400
10	1,990	2,000	2,060	2,070	2,150	2,500	2,600	3,850	6,500	2,200	1,800	2,000
11	1,950	1,975	2,050	2,130	2,150	2,500	2,550	3,750	7,500	1,750	1,800	1,900
12	1,940	1,975	2,030	2,100	2,150	2,500	2,500	3,600	10,800	1,900	1,700	1,800
13	2,000	1,960	1,940	2,080	2,150	2,500	2,300	3,600	12,000	2,100	1,800	1,800
14	1,950	1,950	2,030	2,080	2,150	2,480	1,900	3,600	11,000	1,600	1,800	2,000
15	1,930	1,940	2,080	2,080	2,150	2,500	1,900	3,450	11,000	1,600	1,900	2,000
16	1,930	1,950	2,000	2,080	2,150	2,500	1,890	3,300	11,000	2,100	2,100	2,100
17	1,940	1,970	2,000	2,100	2,150	2,500	1,830	3,300	12,000	2,000	2,100	2,300
18	1,950	2,040	2,030	2,150	2,150	2,460	2,080	3,300	20,000	2,000	2,200	2,200
19	1,950	2,080	2,050	2,120	2,250	2,280	2,420	3,300	18,000	1,900	2,000	2,000
20	2,150	2,030	2,050	2,100	2,450	2,320	3,300	3,350	17,500	1,900	2,500	2,300
21	2,060	1,950	2,080	2,100	2,500	2,300	3,600	4,100	18,000	1,900	2,600	2,300
22	1,800	1,980	2,150	2,100	2,500	2,280	4,500	3,700	17,600	2,000	2,700	2,300
23	1,860	2,050	2,150	2,100	2,500	2,250	5,900	3,600	17,400	2,000	2,300	2,300
24	1,940	2,350	2,150	2,100	2,500	2,400	5,300	4,200	16,000	1,900	2,200	2,200
25	1,940	2,850	2,170	2,100	2,500	2,400	4,600	4,700	15,200	1,900	2,300	2,000
26	1,970	2,700	2,150	2,100	2,500	2,400	4,450	4,450	13,900	2,000	2,400	1,800
27	1,990	2,470	2,075	2,100	2,550	2,500	4,350	4,350	12,800	2,000	2,200	1,700
28	1,970	2,350	2,100	2,100	2,470	2,650	4,200	4,000	11,200	1,700	2,200	1,800
29	1,970	2,200	2,060	2,100	....	2,400	4,200	3,800	10,500	1,500	2,000	1,900
30	1,960	2,570	1,930	2,150	....	2,400	4,700	4,050	10,600	2,500	2,000	1,900
31	1,930	....	1,900	2,150	....	2,400	....	3,950	....	2,500	1,800	....

NOTE.—Discharge Sept. 3 estimated.

Monthly discharge of Androscoggin River at Berlin, N. H., for the year ending Sept. 30, 1917.

[Drainage area, 1,350 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	2,600	1,800	2,000	1.48	1.71
November	2,850	1,930	2,100	1.56	1.74
December	3,500	1,900	2,170	1.61	1.86
January	2,150	1,980	2,070	1.53	1.76
February	2,550	2,150	2,260	1.67	1.74
March	2,650	2,250	2,450	1.81	2.09
April	5,900	1,830	3,140	2.33	2.60
May	4,700	3,300	3,880	2.87	3.31
June	20,000	3,600	10,600	7.85	8.76
July	10,600	1,500	2,860	2.12	2.44
August	2,700	1,700	2,030	1.50	1.73
September	2,400	1,700	2,010	1.52	1.70
The year	20,000	1,500	3,120	2.31	31.44

NOTE.—The monthly discharge in second-feet per square mile and the run-off in depth in inches do not represent the natural flow from the basin because of artificial storage. The yearly discharge and run-off doubtless represent more nearly the natural flow, for probably little stored water is held over from year to year.

ANDROSCOGGIN RIVER AT RUMFORD FALLS, MAINE.

Location.—At dam of Rumford Falls Power Co. at Rumford, Oxford County.

Drainage area.—2,090 square miles.

Records available.—May 18, 1892, to September 30, 1917.

Gages.—One in pond above dam; another in tailrace of power house.

Discharge.—Computed from discharge over the dam by use of the Francis weir formula with modified coefficient, and the quantities passing through the various wheels of the power house, which have been carefully rated.

Ice.—Stage-discharge relation little affected by ice.

Regulation.—Storage in Rangeley system of lakes at headwaters of Androscoggin River aggregates about 29.6 billion cubic feet. The stored water is regulated in the interests of the water-power users below. Results not corrected for storage.

Cooperation.—Records obtained and computations made by Charles A. Mixer, engineer, Rumford Falls Power Co.

Daily discharge, in second-feet, of Androscoggin River at Rumford Falls, Maine, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	[illegible]	[illegible]	[illegible]	[illegible]	2,490	[illegible]	4,250	7,110	5,930	5,320	2,410	2,940
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4,470	[illegible]	5,580	6,730	2,560	2,300
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4,550	[illegible]	5,370	5,710	2,550	2,130
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6,730	4,750	2,430	2,570
5	[illegible]	[illegible]	3,340	[illegible]	[illegible]	[illegible]	5,220	5,920	5,750	4,730	2,000	2,600
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5,430	5,490	4,980	3,580	2,490	2,580
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6,440	5,220	4,720	2,980	2,480	2,530
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6,330	5,190	5,140	2,580	2,390	2,450
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4,440	5,360	6,490	2,980	2,520	2,160
10	2,440	[illegible]	[illegible]	2,430	[illegible]	[illegible]	4,120	5,330	6,640	3,000	2,770	2,340
11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2,790	3,920	5,310	13,900	2,780	2,730	2,200
12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5,430	21,700	2,710	2,190	2,270
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2,740	[illegible]	4,930	19,700	2,900	2,540	2,250
14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5,430	14,900	2,900	2,400	2,250
15	[illegible]	2,340	[illegible]	[illegible]	[illegible]	2,500	3,470	6,100	14,900	2,330	2,680	2,280
16	2,530	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3,420	5,310	13,700	2,910	2,530	1,800
17	2,340	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4,670	14,510	2,930	3,270	2,300
18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5,100	30,300	2,750	3,580	2,280
19	2,440	[illegible]	2,450	[illegible]	2,550	2,540	[illegible]	5,510	23,400	2,740	2,520	2,250
20	[illegible]	[illegible]	[illegible]	2,500	2,530	2,460	[illegible]	[illegible]	17,300	2,710	2,970	2,380
21	3,490	[illegible]	[illegible]	2,430	[illegible]	2,470	9,790	7,430	[illegible]	2,490	3,930	2,420
22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5,460	16,700	2,400	3,570	2,570
23	2,740	2,450	[illegible]	[illegible]	2,560	[illegible]	12,500	5,400	15,900	2,650	3,330	2,060
24	[illegible]	4,440	2,960	2,450	2,710	[illegible]	[illegible]	6,680	14,000	2,470	4,500	2,460
25	[illegible]	4,130	2,330	2,490	2,370	2,430	9,040	6,480	13,200	2,530	5,380	2,310
26	2,560	1,990	2,550	2,470	2,900	3,280	7,380	5,710	11,400	2,630	3,530	2,330
27	2,530	[illegible]	2,550	[illegible]	2,880	[illegible]	6,430	4,940	10,200	2,510	3,480	2,400
28	2,440	[illegible]	[illegible]	[illegible]	2,910	7,640	[illegible]	4,930	9,170	2,550	3,020	2,280
29	2,240	3,130	[illegible]	2,430	......	7,280	6,450	4,970	8,630	2,040	2,980	2,160
30	2,570	4,960	[illegible]	2,720	......	5,530	7,960	6,030	9,330	2,380	2,960	2,020
31	2,480	......	2,140	2,510	......	4,450	......	5,540	......	2,400	3,160	......

Monthly discharge of Androscoggin River at Rumford Falls, Maine, for the year ending Sept. 30, 1917.

[Drainage area, 2,090 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	3,640	1,930	2,540	1.22	1.41
November	4,960	1,970	2,630	1.26	1.41
December	8,950	2,050	2,990	1.43	1.65
January	2,930	2,030	2,510	1.20	1.38
February	2,910	2,150	2,510	1.20	1.25
March	7,640	2,340	3,220	1.54	1.78
April	13,500	3,470	6,070	2.90	3.24
May	7,430	4,930	5,690	2.72	3.14
June	30,300	4,720	12,200	5.85	6.53
July	8,310	2,090	3,220	1.54	1.78
August	5,380	2,000	2,990	1.43	1.65
September	2,870	1,800	2,350	1.12	1.25
The year	30,300	1,800	4,070	1.95	26.47

NOTE.—The monthly discharge in second-feet per square mile and the run-off in depth in inches do not represent the natural flow from the basin because of artificial storage.

MAGALLOWAY RIVER AT AZISCOHOS DAM, MAINE.

LOCATION.—At Aziscohos dam, Oxford County, about 15 miles above mouth.

DRAINAGE AREA.—215 square miles.

RECORDS AVAILABLE.—January 1, 1912, to September 30, 1917.

GAGE.—Vertical staff in two sections, the lower attached to one of the concrete buttresses of the dam and the upper on the concrete gate tower.

DETERMINATION OF DISCHARGE.—Discharge determined from readings of gate openings. Gates have been rated by current-meter measurements at a station about a mile below the dam.

REGULATION.—The capacity of the storage reservoir above the dam is 9,593,000,000 cubic feet, and the discharge is regulated for power interests below. The operation of the gates is planned to maintain as nearly as possible a constant flow at Berlin, N. H. Results not corrected for storage.

COOPERATION.—Discharge computed and furnished for publication by Walter H. Sawyer, agent Union Water Power Co., Lewiston, Maine.

ANDROSCOGGIN RIVER AT RUMFORD FALLS, MAINE.

Location.—At dam of Rumford Falls Power Co. at Rumford, Oxford County.

Drainage area.—2,090 square miles.

Records available.—May 18, 1892, to September 30, 1917.

Gages.—One in pond above dam; another in tailrace of power house.

Discharge.—Computed from discharge over the dam by use of the Francis weir formula with modified coefficient, and the quantities passing through the various wheels of the power house, which have been carefully rated.

Ice.—Stage-discharge relation little affected by ice.

Regulation.—Storage in Rangeley system of lakes at headwaters of Androscoggin River aggregates about 29.6 billion cubic feet. The stored water is regulated in the interests of the water-power users below. Results not corrected for storage.

Cooperation.—Records obtained and computations made by Charles A. Mixer, engineer, Rumford Falls Power Co.

Daily discharge, in second-feet, of Androscoggin River at Rumford Falls, Maine, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,670	2,440	8,950	2,300	2,490	2,920	4,230	7,110	5,520	8,310	2,410	2,840
2	2,850	2,590	5,370	2,530	2,500	2,890	4,470	6,620	5,580	6,730	2,560	2,360
3	2,650	2,630	3,640	2,460	2,450	2,880	4,550	6,210	5,370	5,710	2,550	2,150
4	2,470	2,540	3,260	2,410	2,400	2,760	4,760	6,030	6,730	4,760	2,430	2,870
5	2,410	2,250	3,240	2,450	2,520	2,880	5,020	5,920	5,750	4,730	2,000	2,690
6	2,330	2,420	3,410	2,490	2,490	2,860	5,430	5,490	4,990	3,590	2,490	2,590
7	2,350	2,420	3,380	2,030	2,480	2,820	6,440	5,220	4,720	2,980	2,400	2,530
8	1,930	2,360	3,240	2,350	2,450	2,870	6,030	5,080	5,040	2,590	2,360	2,450
9	2,510	2,380	3,060	2,420	2,510	2,840	4,940	5,260	6,460	2,680	2,520	[illegible]
10	2,440	2,410	2,950	2,430	2,470	2,800	4,130	5,330	6,640	3,000	2,770	2,380
11	2,470	2,480	2,980	2,370	2,190	2,790	3,820	5,310	13,800	2,780	[illegible]	[illegible]
12	2,330	2,250	2,920	2,330	2,430	2,830	3,980	5,430	21,700	2,710	[illegible]	2,270
13	2,280	2,470	2,290	2,280	2,430	2,730	4,040	4,930	19,700	2,800	[illegible]	[illegible]
14	2,480	2,430	2,050	2,180	2,430	2,680	3,930	5,430	14,800	2,800	[illegible]	[illegible]
15	2,030	2,340	2,370	2,920	2,410	2,800	3,470	6,100	14,900	2,330	[illegible]	[illegible]
16	2,520	2,370	2,270	2,930	2,470	2,810	3,920	5,310	13,700	2,810	[illegible]	[illegible]
17	2,390	2,300	2,230	2,890	2,460	2,730	3,820	4,670	14,500	2,820	[illegible]	[illegible]
18	2,340	2,390	2,230	2,810	2,150	2,340	4,560	5,000	30,300	2,760	[illegible]	[illegible]
19	2,400	1,970	2,450	2,750	2,550	2,540	5,700	5,510	23,400	2,740	[illegible]	[illegible]
20	3,640	2,570	2,550	2,600	2,530	2,460	7,900	6,400	17,300	2,710	[illegible]	[illegible]
21	3,490	2,310	2,570	2,430	2,620	2,470	9,060	7,430	16,900	2,660	[illegible]	[illegible]
22	2,650	2,070	2,690	[illegible]	2,660	2,510	11,100	5,960	16,700	2,400	[illegible]	[illegible]
23	2,790	2,450	2,880	[illegible]	2,680	2,540	13,500	5,400	15,800	2,650	[illegible]	[illegible]
24	2,690	4,440	2,860	[illegible]	2,700	2,650	11,000	6,680	14,000	2,470	[illegible]	[illegible]
25	2,650	4,190	[illegible]	[illegible]	[illegible]	2,620	8,040	6,480	13,200	2,830	[illegible]	[illegible]
26	2,580	1,980	[illegible]	[illegible]	[illegible]	3,280	7,380	5,710	11,600	2,630	[illegible]	[illegible]
27	2,530	2,510	[illegible]	[illegible]	[illegible]	[illegible]	6,430	4,940	10,200	2,510	[illegible]	[illegible]
28	2,490	2,930	[illegible]	[illegible]	[illegible]	[illegible]	6,110	4,930	9,170	2,550	3,020	[illegible]
29	2,290	[illegible]	[illegible]	[illegible]		[illegible]	6,450	4,970	8,620	2,090	2,880	2,160
30	2,550	[illegible]	[illegible]	[illegible]		5,330	7,960	6,030	9,330	2,380	2,960	[illegible]
31	2,490		[illegible]	[illegible]		4,450	......	5,540	......	2,400	3,100	......

Monthly discharge of Androscoggin River at Rumford Falls, [illegible] Sept. 30, 1917.

[Drainage area, 2,090 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	3,640	1,930	[illegible]	[illegible]	[illegible]
November	4,960	1,670	[illegible]	[illegible]	[illegible]
December	6,950	2,050	[illegible]	[illegible]	[illegible]
January	2,930	2,030	[illegible]	[illegible]	[illegible]
February	2,910	2,150	[illegible]	[illegible]	[illegible]
March	7,040	2,240	[illegible]	[illegible]	[illegible]
April	12,500	2,450	[illegible]	[illegible]	[illegible]
May	7,430	4,330	[illegible]	[illegible]	[illegible]
June	30,300	4,720	[illegible]	[illegible]	[illegible]
July	6,210	2,000	[illegible]	[illegible]	[illegible]
August	5,380	2,000	[illegible]	[illegible]	[illegible]
September	2,870	1,860	[illegible]	[illegible]	[illegible]
The year	30,300	1,860	[illegible]	[illegible]	[illegible]

NOTE.—The monthly discharge in second-feet per square mile and the run-off in depth [illegible] represent the natural flow from the basin because of artificial storage.

MAGALLOWAY RIVER AT AZISCOHOS DAM, MAINE.

LOCATION.—At Aziscohos dam, Oxford County, about [illegible]

DRAINAGE AREA.—215 square miles.

RECORDS AVAILABLE.—January 1, 1912, to September 30, 1917.

GAGE.—Vertical staff in two sections, the lower attached [illegible] tresses of the dam and the upper on the concrete gate house.

DETERMINATION OF DISCHARGE.—Discharge determined [illegible] ings. Gates have been rated by current-meter measurements [illegible] a mile below the dam.

REGULATION.—The capacity of the storage reservoir [illegible] cubic feet, and the discharge is regulated for power [illegible] tion of the gates is planned to maintain [illegible] Berlin, N. H. Results not corrected for storage.

COOPERATION.—Discharge computed and furnished [illegible] [illegible], agent Union Water Power Co., [illegible]

[illegible] t

[illegible] 6,

[illegible] n of

[illegible] iderable

[illegible] 'alls probably

[illegible] December to April.

[illegible] cond-feet. Daily dis-

[illegible] to rating table. Open-

[illegible], during the year ending Sept. 30,

[illegible]	Date.	Made by—	Gage height.	Discharge.
c.-ft.			Feet.	Sec.-ft.
1,150	May 1	F. E. Pressey	5.72	8,350
1,290	8	.....do	5.04	6,570
6,700	17	.....do	4.50	4,960
6,740	25	.....do	4.36	5,310

[illegible] -discharge relation affected by ice.

Monthly discharge of Magalloway River at Aziscohos dam, Maine, for the year ending Sept. 30, 1917.

[Drainage area, 215 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,880	95	1,220	5.67	6.54
November	1,450	86	946	4.40	4.91
December	1,400	87	514	2.39	2.76
January	184	183	183	.85	.98
February	801	165	359	1.67	1.74
March	1,560	164	957	4.45	5.13
April	1,070	76	240	1.12	1.25
May	1,200	81	277	1.29	1.49
June	4,680	99	1,650	7.67	8.56
July	1,610	216	404	1.88	2.17
August	1,780	99	548	2.55	2.94
September	1,880	502	1,400	6.53	7.29
The year	4,680	76	724	3.37	45.76

NOTE.—The monthly discharge in second-feet per square mile and the run-off in depth in inches do not represent the natural flow from the basin because of artificial storage. The yearly discharge and run-off doubtless represent more nearly the natural flow, for probably little stored water is held over from year to year.

LITTLE ANDROSCOGGIN RIVER NEAR SOUTH PARIS, MAINE.

LOCATION.—At left end of an old dam at Bisco Falls, 200 feet below highway bridge and 5 miles above South Paris, Oxford County.

DRAINAGE AREA.—75 square miles.

RECORDS AVAILABLE.—September 14, 1913, to September 30, 1917.

GAGE.—Chain on left bank installed April 16, 1914; original gage, a vertical staff, was destroyed by ice March 2, 1914; from March 18 to April 9, 1914, a chain gage on a footbridge was used; all gages referred to same datum and at practically same place. Gage read by G. A. Jackson.

DISCHARGE MEASUREMENTS.—Made from highway bridge or by wading.

CHANNEL AND CONTROL.—At low and medium stages water flows through opening at left of old stone dam; opening was enlarged by high water of April 9, 1914; water flows over dam at gage height 5.30 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.4 feet at 7 p. m. June 12 (discharge, 2,070 second-feet); minimum stage recorded during year, 1.5 feet several times in July and August (discharge, 20 second-feet).

ICE.—Control remains open throughout the winter; stage-discharge relation not affected by ice.

REGULATION.—Storage at Snows Falls, 1½ miles above the station, and at West Paris, 4 miles above, has some effect on regimen of stream.

ACCURACY.—Stage-discharge relation changed at the time of high water April 9, 1914; otherwise practically permanent. Rating curve well defined below 700 second-feet and fairly well defined between 700 and 1,800 second-feet. Gage read to tenths once daily. Daily discharge ascertained by applying rating table to daily gage height. Records good except for times of sudden changes in stage, when the number of gage readings is insufficient to determine accurately the mean daily flow.

Discharge measurements of Little Androscoggin River near South Paris, Maine, during the year ending Sept. 30, 1917.

[Made by G. C. Danforth.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
April 16	5.81	421
Sept. 25	1.94	43.6

Daily discharge, in second-feet, of Little Androscoggin River near South Paris, Maine, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	108	90	1,180	108	61	61	493	314	159	219	24	108
2	92	108	493	108	61	68	475	292	159	179	20	92
3	84	92	303	100	68	68	512	303	140	169	20	76
4	84	76	199	116	68	61	475	325	179	116	24	76
5	84	61	179	124	61	61	458	303	132	108	20	61
6	76	76	209	124	61	61	585	270	116	108	24	47
7	76	61	199	100	61	54	1,280	239	108	92	20	47
8	40	61	149	116	61	54	700	229	124	68	20	47
9	76	54	149	124	47	61	558	229	189	68	20	40
10	68	54	124	124	47	61	458	219	199	68	20	40
11	61	61	124	116	47	61	348	189	760	76	24	34
12	68	40	132	108	47	61	360	169	1,970	92	24	34
13	68	47	132	84	54	61	348	219	1,080	100	24	29
14	61	40	124	108	54	61	426	199	535	92	24	29
15	47	61	100	239	54	68	458	219	585	92	24	24
16	61	61	100	209	54	76	426	159	493	76	29	24
17	61	68	108	189	54	76	493	140	1,180	61	84	29
18	54	68	100	179	54	68	512	132	1,180	47	169	34
19	61	47	108	140	54	61	535	124	830	47	92	40
20	372	84	100	124	54	61	585	108	615	29	108	47
21	229	68	108	116	54	61	830	116	493	24	239	68
22	169	61	116	108	54	68	760	116	458	24	140	54
23	132	61	372	92	54	76	615	209	348	20	116	54
24	124	314	270	92	61	108	458	249	303	29	189	47
25	116	124	219	100	54	116	442	209	360	34	348	40
26	116	108	159	100	61	140	411	149	303	34	281	40
27	84	108	159	84	68	239	384	132	229	29	140	34
28	84	100	140	84	68	900	360	132	179	29	140	34
29	54	108	124	92	....	900	348	169	132	29	169	30
30	76	360	108	84	....	585	348	239	384	29	169	24
31	68	....	108	68	....	493	....	199	....	24	159	....

NOTE.—Discharge estimated Feb. 15–22.

Monthly discharge of Little Androscoggin River near South Paris, Maine, for the year ending Sept. 30, 1917.

[Drainage area, 75 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	372	40	95.3	1.27	1.46
November	360	40	90.7	1.21	1.35
December	1,180	100	200	2.67	3.08
January	239	68	118	1.57	1.81
February	68	47	57.0	.760	.79
March	900	54	160	2.13	2.46
April	1,280	348	515	6.87	7.66
May	325	108	203	2.71	3.12
June	1,970	108	464	6.19	6.91
July	219	20	71.4	.952	1.10
August	348	20	93.7	1.25	1.44
September	108	24	46.1	.615	.67
The year	1,970	20	176	2.35	31.85

PRESUMPSCOT RIVER BASIN.

PRESUMPSCOT RIVER AT OUTLET OF SEBAGO LAKE, MAINE.

Location.—At outlet dam at Sebago Lake and hydroelectric plant at Eel Weir Falls, Cumberland County, 1 mile below lake outlet.

Drainage area.—436 square miles.

Records available.—January 1, 1887, to September 30, 1917. Results of a recomputation of all data from 1887 to 1911 are published in the second annual report of Maine State Water Storage Commission.

Gages.—On bulkhead of gatehouse at outlet dam and in forebay and tailrace of power plant.

Discharge.—Prior to March, 1904, discharge was determined from records of opening of gates in dam; since March, 1904, flow from lake has been recorded by three Allen meters, one on each of three pairs of 30-inch Hercules wheels; wheels and recording meters checked by current-meter measurements, brake tests of wheels, and electrical readings of the generator output. Water wasted at regulating gates is measured from records of gate openings and coefficients determined from current-meter measurements.

Ice.—Stage-discharge relation not affected by ice.

Regulation.—Sebago Lake (area, 46 square miles) is under complete regulation. Results not corrected for storage.

Cooperation.—Entire record furnished by S. D. Warren Co.

Daily discharge, in second-feet, of Presumpscot River at outlet of Sebago Lake, Maine, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	333	875	673	760	810	842	212	842	720	2,480	790	720
2	795	755	792	828	812	827	737	787	740	2,450	767	45
3	867	845	342	827	833	837	798	828	253	2,400	703	237
4	893	882	793	858	283	307	780	813	743	2,360	760	740
5	802	332	840	835	775	790	812	752	705	2,350	210	783
6	857	863	811	733	830	840	667	270	768	2,330	758	727
7	883	870	868	300	837	838	562	813	745	2,180	758	832
8	242	848	820	808	837	835	222	842	722	2,240	757	752
9	890	788	782	792	845	835	843	837	707	1,650	762	280
10	845	837	365	808	842	800	807	730	245	847	760	786
11	897	827	817	737	345	252	780	795	623	835	762	797
12	853	503	837	840	830	842	842	800	828	808	240	815
13	783	807	825	840	835	845	802	275	965	807	737	806
14	837	808	828	267	837	835	693	823	697	792	758	808
15	360	840	785	695	812	840	340	755	738	285	757	808
16	888	875	807	777	825	807	788	793	1,080	770	778	268
17	830	870	275	787	773	728	803	807	1,800	768	758	798
18	828	808	845	832	318	322	798	785	2,330	765	722	805
19	870	383	833	768	842	835	792	705	2,420	712	262	808
20	902	830	838	827	842	843	833	247	2,470	632	770	812
21	858	790	790	277	812	850	773	765	2,530	617	753	807
22	262	875	760	743	840	840	255	780	2,660	182	758	722
23	835	877	755	820	813	838	832	738	2,690	752	735	305
24	830	670	222	830	838	832	840	735	2,730	753	757	793
25	795	762	273	840	410	213	777	808	2,700	752	733	812
26	880	317	697	813	818	700	838	727	2,690	762	260	807
27	878	882	845	802	820	693	888	295	2,710	780	783	802
28	678	855	837	318	830	752	650	807	2,700	743	767	797
29	327	825	787	802	....	700	385	712	2,500	263	770	762
30	892	730	723	835	....	743	812	705	2,500	768	773	300
31	887	....	347	840	....	708	....	757	....	787	770	....

Monthly discharge of Presumpscot River at outlet of Sebago Lake, Maine, for the year ending Sept. 30, 1917.

[Drainage area, 436 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	902	242	761	1.75	2.02
November	882	317	768	1.76	1.96
December	845	222	704	1.61	1.86
January	858	277	737	1.69	1.95
February	845	283	755	1.73	1.80
March	845	213	734	1.68	1.94
April	888	212	699	1.60	1.78
May	842	247	714	1.64	1.89
June	2,730	245	1,560	3.58	3.99
July	2,480	182	1,150	2.64	3.04
August	790	210	691	1.58	1.82
September	832	45	677	1.55	1.73
The year	2.730	45	828	1.90	25.78

NOTE.—The monthly discharge in second-feet per square mile and the run-off in depth in inches do not represent the natural flow from the basin because of artificial storage. The yearly discharge and run-off doubtless represent more nearly the natural flow, for probably little stored water is held over from year to year.

SACO RIVER BASIN.

SACO RIVER AT CORNISH, MAINE.

LOCATION.—At highway bridge at Cornish, York County, half a mile below mouth of Ossipee River.

DRAINAGE AREA.—1,300 square miles.

RECORDS AVAILABLE.—June 4, 1916, to September 30, 1917.

GAGE.—Chain attached to bridge; read by S. J. Elliott.

DISCHARGE MEASUREMENTS.—Made from bridge.

CHANNEL AND CONTROL.—Bed covered with sand and boulders. Channel broken by one pier at bridge.

EXTREMES OF DISCHARGE.—Maximum stage during period covered by record, 9.4 feet at 6.30 a. m. June 18, 1917 (discharge, from extension of rating curve, about 17,400 second-feet); minimum stage recorded, 0.8 foot at 4.30 p. m. August 16, 6.30 a. m. September 11 and September 22, 1917 (discharge, from extension of rating curve, about 635 second-feet).

ICE.—Stage-discharge relation seriously affected by ice which forms to considerable thickness.

REGULATION.—The operation of power plants at Swan Falls and Kezar Falls probably has little effect on flow at station.

ACCURACY.—Stage-discharge relation seriously affected by ice December to April. Rating curve fairly well defined between 1,000 and 9,000 second-feet. Daily discharge ascertained by applying mean daily gage height to rating table. Open-water records good; winter records fair.

Discharge measurements of Saco River at Cornish, Maine, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 14	E. W. Conners	1.47	1,150	May 1	F. E. Pressey	5.72	8 350
Feb. 2	....do	[a]3.71	1,290	8	....do	5.04	6,570
Apr. 12	F. E. Pressey	5.05	6,700	17	....do	4.50	4,960
20	G. C. Danforth	4.97	6,740	25	....do	4.36	5,310

[a] Stage-discharge relation affected by ice.

Monthly discharge of Saco River at Cornish, Maine, for the period June 4, 1916, to Sept. 30, 1917.

[Drainage area, 1,300 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1916.					
June 4-30	10,900	4,420	7,660	5.89	5.91
July	6,180	2,140	3,760	2.89	3.33
August	2,680	1,260	1,730	1.33	1.53
September	2,400	1,010	1,520	1.17	1.30
1916-17.					
October	1,900	1,090	1,440	1.11	1.28
November	2,820	1,010	1,420	1.09	1.22
December	4,780	1,570	2,720	2.09	2.41
January	1,900	1,360	1,710	1.32	1.52
February	1,360	1,180	1,280	.985	1.03
March	6,180	1,260	2,000	1.54	1.78
April	10,900	5,750	7,800	6.00	6.69
May	8,250	4,600	5,850	4.50	5.19
June	16,900	4,260	8,740	6.72	7.50
July	6,180	1,460	3,090	2.38	2.74
August	2,400	635	1,470	1.13	1.30
September	2,140	700	1,200	.923	1.03
The year	16,900	635	3,220	2.48	33.69

OSSIPEE RIVER AT CORNISH, MAINE.

LOCATION.—At highway bridge in Cornish, York County, 1¼ miles above confluence with Saco River.

DRAINAGE AREA.—448 square miles.

RECORDS AVAILABLE.—July 5, 1916, to September 30, 1917.

GAGE.—Chain attached to bridge; read by O. W. Adams.

DISCHARGE MEASUREMENTS.—Made from bridge.

CHANNEL AND CONTROL.—Bed covered with sand and gravel; possibly shifting somewhat. Channel broken by one pier at bridge.

EXTREMES OF DISCHARGE—Maximum stage during period covered by record, 7.25 feet at 6 a. m. June 18, 1917 (discharge, from extension of rating curve, about 6,480 second-feet); minimum stage, 1.0 feet several times in September and October, 1916, and 7 a. m. September 22, and 2 p. m. September 23, 1917 (discharge, 320 second-feet).

ICE.—Stage-discharge relation seriously affected by ice which forms to considerable thickness.

REGULATION.—Flow affected by dams at Kezar Falls and at outlet of Great Ossipee Lake.

ACCURACY.—Stage-discharge relation affected by ice December 14 to March 26. Rating curve fairly well defined between 350 and 2,400 second-feet. Gage read to half tenths once daily. Discharge determined by applying daily gage height to rating table. Records fair.

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[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Sept.

[illegible] discharge determined from gage [illegible] weather records, and a comparison with Saco River [illegible]

Monthly discharge of Ossipee River at Cornish, Maine, for the period July 5, 1916, to Sept. 30, 1917.

[Drainage area, 448 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1916.					
July 5-31	2,930	740	1,340	2.99	3.00
August	1,040	360	646	1.44	1.66
September	980	320	541	1.21	1.35
1916-17.					
October	800	320	469	1.05	1.21
November	800	360	522	1.17	1.30
December	1,500	580	925	2.06	2.38
January	800	462	634	1.41	1.63
February	555	400	464	1.04	1.08
March	2,710	400	817	1.82	2.10
April	3,720	2,080	2,650	5.92	6.60
May	2,180	1,040	1,530	3.42	3.94
June	6,410	920	2,630	5.87	6.55
July	1,880	462	891	1.99	2.29
August	680	380	532	1.19	1.37
September	630	300	423	0.944	1.09
The year	6,410	300	1,040	2.32	31.54

MERRIMACK RIVER BASIN.

MERRIMACK RIVER AT FRANKLIN JUNCTION, N. H.

LOCATION.—At covered wooden bridge of Boston & Maine Railroad near Franklin Junction, Merrimack County, about a mile below confluence of Pemigewasset and Winnepesaukee rivers.

DRAINAGE AREA.—1,460 square miles.

RECORDS AVAILABLE.—July 8, 1903, to September 30, 1917.

GAGE.—Chain gage fastened to floor of bridge on upstream side over west channel; read by F. R. Roers. A gage painted on the downstream right-hand side of the center pier of the bridge is considerably in error for low stages.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of coarse gravel and boulders; fairly permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 15.1 feet at 5 p. m. June 18 (discharge, by extension of rating curve, 22,500 second-feet); minimum stage recorded, 3.95 feet at 6 a. m. August 13 (discharge, 1,040 second-feet).

ICE.—Stage-discharge relation seriously affected by ice during most winters.

REGULATION.—Flow affected by storage in Winnepesaukee, Squam, and New Found Lakes and by the operation of mills above the station.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice December 17 to March 28. Rating curve fairly well defined below 10,000 second-feet. Gage read to half-tenths twice daily as a rule but readings were omitted at frequent intervals; accuracy of readings somewhat uncertain. Daily discharge ascertained by applying mean daily gage height to rating table with corrections for ice during winter. Records fair.

COOPERATION.—Gage-height record furnished by the proprietors of locks and canals on Merrimack River, Lowell, Mass.

The following discharge measurement was made by M. R. Stackpole:

July 16, 1917: Gage-height 4.83 feet; discharge 1,870 second-feet.

Daily discharge, in second-feet, of Merrimack River at Franklin Junction, N. H., for the year ending Sept. 30, 1907.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
23	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
26	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
28	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
29	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
31	[illegible]		[illegible]		[illegible]		[illegible]	[illegible]	

NOTE.—Discharge on Sundays and other days when gage was not read estimated by comparison with other gaging stations.

Monthly discharge of Merrimack River at Franklin Junction, N. H., for the year ending Sept. 30, 1907.

[Drainage area, 1,460 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	2,280	1,440	1,670	1.14	1.31
November	4,660	1,080	1,780	1.22	1.36
December	20,800	1,450	2,850	1.95	2.25
January			1,550	1.06	1.22
February			1,280	.983	.90
March			3,430	2.35	2.71
April	15,700	3,120	6,730	4.61	5.14
May	6,000	3,790	5,070	3.47	4.00
June	20,500	3,450	7,290	4.99	5.57
July	4,300	1,350	2,180	1.49	1.72
August	1,930	1,080	1,440	.986	1.14
September	1,930	1,170	1,480	1.01	1.13
The year	20,500	1,080	3,060	2.10	28.45

NOTE.—Mean monthly discharge for January, February, and March estimated on basis of 1.7 times discharge of Pemigewasset River at Plymouth plus discharge from Lake Winnepesaukee at Lakeport.

MERRIMACK RIVER AT LAWRENCE, MASS.

Location.—At dam of Essex Co. in Lawrence, Essex County.

Drainage area.[1]—Total of Merrimack River basin above Lawrence, 4,663 square miles; net drainage area, exclusive of diverted parts of Nashua and Sudbury River and Lake Cochituate basins, 4,552 square miles.

Records available.—January 1, 1880, to September 30, 1917.

Computations of discharge.—Accurate record is kept of the flow over the dam and through the various wheels and gates. This flow includes the water wasted into the Merrimack from the Nashua, Sudbury, and Cochituate drainage basins. Estimates of the quantity wasted from these basins is furnished by the Metropolitan Water and Sewerage Board of Boston and subtracted from the quantity measured at Lawrence to obtain the net flow from the net drainage area of 4,452 square miles.

Diversions.—Practically the entire flow of the South Branch of Nashua River, Sudbury River, and Lake Cochituate is diverted for use by the Metropolitan water district of Boston.

Regulation.—Flow regulated to some extent by storage in Lake Winnepesaukee. The low water flow of the stream is affected by operation of various power plants above Lawrence.

Storage.—There are several reservoirs in the basin. It is estimated that the water surface is about 3.5 per cent of the entire drainage area.

Cooperation.—The entire record has been furnished by R. A. Hale, principal assistant engineer of the Essex Co. Record changed to climatic year form by engineers of the Geological Survey.

Daily discharge, in second-feet, of Merrimack River at Lawrence, Mass., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,943	3,512	5,812	3,118	3,901	7,785	20,326	10,601	8,760	8,649	3,072	2,820
2	6,068	3,254	11,231	5,068	4,052	8,065	19,656	11,093	7,639	9,706	2,391	3,119
3	5,120	3,065	8,842	4,191	2,842	7,277	18,939	12,067	7,414	8,183	2,797	3,267
4	4,462	2,604	7,792	3,793	1,356	6,198	17,305	12,282	9,162	6,324	2,033	5,286
5	3,871	723	6,433	3,836	4,761	7,024	16,468	10,979	9,447	7,508	1,078	4,300
6	3,973	4,265	6,096	2,850	4,042	6,061	16,521	11,290	9,053	6,298	3,940	3,657
7	2,656	3,504	6,172	3,394	3,890	5,621	19,012	13,717	8,781	4,243	3,321	2,984
8	2,054	3,261	6,161	6,538	3,347	5,445	21,526	13,257	8,566	3,710	2,729	2,502
9	4,441	3,153	5,154	6,325	3,699	5,555	20,277	12,095	8,450	5,390	2,623	551
10	3,617	3,121	4,262	6,165	2,872	4,673	17,107	11,383	9,512	3,790	2,929	3,662
11	3,433	2,044	5,764	5,990	1,484	4,847	14,158	10,615	10,909	4,351	2,186	3,150
12	1,416	870	5,462	5,570	4,656	6,527	12,196	9,474	14,802	4,094	501	2,878
13	3,879	4,175	5,199	4,531	3,656	6,248	11,334	9,192	25,107	4,696	2,435	2,717
14	2,961	3,516	5,035	3,903	3,543	6,256	10,295	10,265	25,219	3,964	2,915	2,648
15	527	3,630	4,603	5,866	3,492	6,752	9,502	9,417	19,057	3,829	2,677	1,993
16	3,946	3,554	2,925	5,818	3,531	7,089	9,982	9,297	15,408	5,248	2,298	301
17	3,561	3,271	1,347	6,024	2,733	8,151	9,495	8,821	14,518	4,560	2,885	2,473
18	3,448	2,472	5,028	6,231	1,217	7,657	9,477	7,484	22,986	4,092	2,320	2,672
19	3,141	773	4,046	5,798	4,359	8,772	9,340	6,481	31,490	4,017	1,530	2,655
20	3,174	3,986	3,991	4,520	3,715	7,407	11,443	6,344	26,841	3,837	4,702	2,611
21	2,664	3,551	3,819	3,664	3,686	6,950	13,717	7,764	19,047	2,675	4,189	2,444
22	4,819	3,364	3,863	5,324	1,709	7,106	15,826	8,660	15,474	1,636	3,501	1,531
23	5,725	3,279	2,723	4,797	4,760	7,465	17,763	8,397	12,502	4,473	3,181	269
24	4,749	3,384	4,453	4,132	2,858	9,687	19,221	8,347	10,598	3,881	3,570	2,116
25	4,220	5,200	5,715	4,019	1,504	15,887	16,882	9,920	11,709	3,602	2,473	2,052
26	3,882	6,566	6,551	3,992	4,730	17,009	14,033	8,741	11,862	3,547	673	2,250
27	3,861	5,489	5,536	2,801	5,068	18,083	12,498	7,578	10,618	3,569	4,101	2,312
28	2,861	4,374	5,154	2,103	6,448	24,432	11,056	8,131	9,471	2,525	3,558	2,470
29	827	4,082	4,954	4,923	......	31,116	10,158	7,660	8,576	1,549	3,162	1,856
30	4,441	2,049	3,501	3,971	......	29,951	10,779	7,264	7,306	4,248	3,454	405
31	3,702	......	2,906	3,885	......	25,228	......	9,893	......	3,683	4,128	......

Note.—This table shows the actual flow at Lawrence; not corrected for water wasted by the Metropolitan Water and Sewerage Board.

[1] See footnote to tables of weekly discharge.

Daily discharge, in second-feet, of Merrimack River at Franklin Junction, N. H., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,000	1,700	10,800	8,500	6,000	3,790	4,300	1,440	1,900
2	2,280	1,820	8,720	8,300	5,800	3,960	4,300	1,400	1,790
3	2,040	1,720	6,800	7,880	5,600	4,600	4,000	1,440	1,600
4	1,930	1,720	5,020	7,040	5,800	5,200	3,620	1,440	1,930
5	1,820	1,750	2,820	6,410	5,600	6,000	3,450	1,400	1,530
6	1,720	1,820	3,280	6,410	5,600	4,660	2,970	1,400	1,790
7	1,620	1,720	2,970	8,510	5,600	3,790	2,700	1,350	1,730
8	1,600	1,620	2,680	7,200	5,020	3,450	2,540	1,300	1,620
9	1,620	1,620	2,540	6,000	5,400	5,200	2,280	1,220	1,600
10	1,440	1,530	2,500	4,130	4,840	6,100	2,040	1,300	1,530
11	1,530	1,440	2,410	3,960	4,660	7,040	2,280	1,170	1,350
12	1,550	1,450	2,280	3,790	4,840	14,000	2,280	1,100	1,350
13	1,530	1,480	2,040	3,450	4,800	20,500	2,040	1,080	1,440
14	1,530	1,350	1,900	3,280	4,840	8,930	1,900	1,350	1,490
15	1,600	1,440	1,720	3,200	5,600	6,830	1,820	1,400	1,440
16	1,720	1,260	1,620	3,120	4,840	5,400	1,620	1,440	1,400
17	1,700	1,260	1,600	3,280	4,660	12,300	1,600	1,530	1,350
18	1,720	1,080	1,550	3,620	4,840	19,200	1,620	1,620	1,260
19	1,620	1,150	1,450	3,450	4,840	14,000	1,530	1,650	1,170
20	1,620	1,260	1,450	3,790	5,200	8,300	1,530	1,670	1,170
21	1,530	1,350	1,550	10,400	5,600	7,040	1,600	1,620	1,440
22	1,500	1,350	1,950	13,000	5,800	6,000	1,620	1,620	1,350
23	1,440	1,350	2,280	15,700	5,200	6,100	1,820	1,530	1,400
24	1,530	2,680	2,300	12,100	5,800	6,300	1,720	1,620	1,440
25	1,620	4,660	2,280	10,000	5,300	6,410	1,620	1,530	1,440
26	1,720	3,400	2,160	7,880	4,840	5,600	1,530	1,500	1,350
27	1,720	2,040	2,040	7,250	4,500	4,840	1,530	1,440	1,350
28	1,620	1,820	1,930	7,040	4,130	4,660	1,500	1,350	1,350
29	1,600	2,160	1,820	6,700	3,960	4,300	1,440	1,260	1,350
30	1,620	2,280	1,820	6,410	3,790	4,130	1,350	1,620	1,350
31	1,620	....	2,000	....	3,790	....	1,400	1,930	....

NOTE.—Discharge on Sundays and other days when gage was not read estimated by comparison with other gaging stations.

Monthly discharge of Merrimack River at Franklin Junction, N. H., for the year ending Sept. 30, 1917.

[Drainage area, 1,460 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	2,280	1,440	[illegible]	[illegible]	[illegible]
November	4,660	1,080	[illegible]	[illegible]	[illegible]
December	10,800	1,450	[illegible]	[illegible]	[illegible]
January	....	....	[illegible]	[illegible]	[illegible]
February	....	....	[illegible]	[illegible]	[illegible]
March	....	[illegible]	[illegible]	[illegible]	2.71
April	15,[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
June	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
July	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
August	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
September	[illegible]	[illegible]	1,450	1.[illegible]	[illegible]
The year	[illegible]	[illegible]	3,060	[illegible]	[illegible]

NOTE.—Mean monthly dischar[illegible] estimated [illegible] charge of Pemigewasset River a[illegible] Winnepes[illegible]

MERRIMACK RIVER AT LAWRENCE, MASS.

Location.—At dam of Essex Co. in Lawrence, Essex County.

Drainage area.[1]—Total of Merrimack River basin above Lawrence, 4,663 square miles; net drainage area, exclusive of diverted parts of Nashua and Sudbury River and Lake Cochituate basins, 4,552 square miles.

Records available.—January 1, 1880, to September 30, 1917.

Computations of discharge.—Accurate record is kept of the flow over the dam and through the various wheels and gates. This flow includes the water wasted into the Merrimack from the Nashua, Sudbury, and Cochituate drainage basins. Estimates of the quantity wasted from these basins is furnished by the Metropolitan Water and Sewerage Board of Boston and subtracted from the quantity measured at Lawrence to obtain the net flow from the net drainage area of 4,452 square miles.

Diversions.—Practically the entire flow of the South Branch of Nashua River, Sudbury River, and Lake Cochituate is diverted for use by the Metropolitan water district of Boston.

Regulation.—Flow regulated to some extent by storage in Lake Winnepesaukee. The low water flow of the stream is affected by operation of various power plants above Lawrence.

Storage.—There are several reservoirs in the basin. It is estimated that the water surface is about 3.5 per cent of the entire drainage area.

Cooperation.—The entire record has been furnished by R. A. Hale, principal assistant engineer of the Essex Co. Record changed to climatic year form by engineers of the Geological Survey.

Daily discharge, in second-feet, of Merrimack River at Lawrence, Mass., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,943	3,512	5,812	3,118	3,901	7,785	20,326	10,601	8,760	8,649	3,072	2,820
2	6,068	3,254	11,231	5,068	4,052	8,065	19,656	11,093	7,639	9,706	2,391	3,119
3	5,120	3,065	8,842	4,191	2,842	7,277	18,939	12,067	7,414	8,183	2,797	3,267
4	4,462	2,604	7,792	3,793	1,356	6,198	17,305	12,282	9,162	6,324	2,033	5,286
5	3,871	723	6,433	3,836	4,761	7,024	16,468	10,979	9,447	7,508	1,078	4,300
6	3,973	4,265	6,096	2,850	4,042	6,061	16,521	11,290	9,053	6,298	3,940	3,657
7	2,656	3,504	6,172	3,394	3,890	5,621	19,012	13,717	8,781	4,243	3,321	2,984
8	2,054	3,261	6,161	6,538	3,347	5,445	21,526	13,257	8,566	3,710	2,729	2,502
9	4,441	3,153	5,154	6,325	3,699	5,555	20,277	12,095	8,459	5,390	2,623	551
10	3,617	3,121	4,262	6,165	2,872	4,673	17,107	11,383	9,512	3,799	2,929	3,662
11	3,433	2,044	5,764	5,990	1,484	4,847	14,158	10,615	10,909	4,351	2,186	3,150
12	1,416	870	5,462	5,570	4,656	6,527	12,196	9,474	14,802	4,094	501	2,878
13	3,879	4,175	5,199	4,531	3,656	6,248	11,334	9,192	25,107	4,696	2,435	2,717
14	2,961	[illegible]	[illegible]	3,903	3,543	6,256	10,295	10,265	25,219	3,964	2,915	2,648
15	527	[illegible]	[illegible]	5,866	3,492	6,752	9,502	9,417	19,057	3,829	2,677	[illegible]
16	3,946	[illegible]	[illegible]	5,818	3,531	7,089	9,982	9,297	15,408	5,248	[illegible]	[illegible]
17	[illegible]	[illegible]	[illegible]	[illegible]	2,733	8,151	9,495	8,821	14,518	4,560	[illegible]	[illegible]
18	[illegible]	[illegible]	[illegible]	[illegible]	1,217	7,657	9,477	7,484	22,986	4,092	[illegible]	[illegible]
19	[illegible]	[illegible]	[illegible]	[illegible]	4,359	8,772	9,340	6,481	31,490	4,017	[illegible]	[illegible]
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7,407	11,443	6,344	25,841	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6,950	13,717	7,764	19,047	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7,105	15,825	8,660	15,474	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7,465	17,763	8,397	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9,687	19,221	8,347	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	15,887	16,882	9,920	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17,009	14,033	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	18,083	12,498	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	24,432	11,056	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	31,116	10,158	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	29,951	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	25,228	....	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Weekly discharge, in second-feet, of Merrimack River at Lawrence, Mass., for the year ending Sept. 30, 1917.

[Weeks arranged in order of dryness.]

Week ending Sunday—	Measured at Lawrence (total drainage area, 4,663 square miles).	Wasting into Merrimack River from diverted drainage basins (211 square miles).	From net drainage area of 4,452 square miles.	Per square mile of net drainage area.
Sept. 30	1,923	14	1,909	0.429
23	2,094	15	2,079	0.467
Aug. 19	2,437	14	2,423	0.544
Sept. 16	2,478	16	2,462	0.553
Aug. 12	2,604	12	2,592	0.582
5	2,757	8	2,749	0.617
Nov. 12, 1916	2,888	11	2,877	0.646
Oct. 15, 1916	2,896	9	2,887	0.648
Nov. 5, 1916	3,043	12	3,021	0.681
19, 1916	3,056	20	3,036	0.682
Aug. 26	3,184	16	3,168	0.712
Sept. 9	3,221	25	3,196	0.718
Feb. 25	3,227	51	3,176	0.713
18	3,261	35	3,226	0.725
July 29	3,313	10	3,303	0.742
Feb. 11	3,442	52	3,390	0.761
Sept. 2	3,477	51	3,426	0.770
Oct. 22, 1916	3,536	8	3,528	0.792
Feb. 4	3,561	58	3,503	0.787
July 22	3,724	20	3,704	0.832
Oct. 29, 1916	3,732	11	3,721	0.836
Jan. 7	3,750	27	3,723	0.836
28	3,881	69	3,812	0.856
Dec. 24, 1916	3,989	29	3,960	0.889
Oct. 8, 1916	4,029	7	4,022	0.903
Nov. 26, 1916	4,190	48	4,142	0.930
July 15	4,303	31	4,272	0.960
Dec. 17, 1916	4,334	32	4,302	0.966
31, 1916	4,902	34	4,868	1.093
Jan. 21	5,417	98	5,319	1.195
14	5,575	57	5,518	1.239
Mar. 11	5,604	139	5,465	1.228
Dec. 3, 1916	5,983	58	5,925	1.331
10, 1916	6,010	50	5,960	1.339
Mar. 4	6,510	212	6,298	1.415
July 8	6,567	19	6,548	1.471
Mar. 18	6,954	206	6,748	1.516
June 3	8,109	210	7,899	1.774
May 20	8,301	148	8,153	1.831
27	8,487	68	8,419	1.891
June 10	8,997	63	8,934	2.007
Mar. 25	9,039	225	8,814	1.980
July 1	9,741	43	9,698	2.178
May 6	11,299	172	11,127	2.499
Apr. 22	11,326	72	11,254	2.528
May 13	11,390	260	11,130	2.500
Apr. 15	13,553	111	13,442	3.019
29	14,516	88	14,428	3.241
June 17	17,860	191	17,669	3.969
Apr. 8	18,490	152	18,338	4.119
June 24	19,705	163	19,542	4.389
Apr. 1	23,735	309	23,426	5.262
The year	6,546	74	6,472	1.454

NOTE.—Record of discharge wasted from diverted drainage area based on data furnished by the Metropolitan Water and Sewerage Board of Boston.

Monthly discharge of Merrimack River at Lawrence, Mass., for the year ending Sept. 30, 1917.

Month.	Mean discharge in second-feet.				Run-off.		Rainfall in inches.
	Measured at Lawrence (total drainage area, 4,663 square miles).	Wasting into Merrimack River from diverted drainage basins (211 square miles).	From net drainage area of 4,452 square miles.	Per square mile of net drainage area.	Depth in inches on net drainage area.	Per cent of rainfall.	
October	3,563	9	3,554	0.798	0.920	67.6	1.36
November	3,336	27	3,309	.743	.829	29.8	2.78
December	5,178	40	5,138	1.154	1.330	43.9	3.03
January	4,617	62	4,555	1.023	1.180	38.6	3.06
February	3,497	68	3,429	.770	.802	34.0	2.36
March	10,527	215	10,312	2.316	2.670	70.4	3.79
April	14,543	111	14,432	3.242	3.618	160.1	2.26
May	9,629	172	9,457	2.124	2.449	63.6	3.85
June	13,643	124	13,519	3.037	3.389	60.2	5.63
July	4,578	20	4,558	1.024	1.181	72.0	1.64
August	2,818	17	2,801	.629	.725	15.5	4.69
September	2,465	21	2,444	.549	.613	53.3	1.15
The year	6,536	74	6,462	1.451	19.706	55.4	35.60

NOTE.—The monthly discharge in second-feet, per square mile, and the run-off in depth in inches, shown by the table, do not represent the natural flow from the basin because of artificial storage.

SOUHEGAN RIVER AT MERRIMACK, N. H.

LOCATION.—At the head of Atherton Falls, 7 miles below mouth of Beaver Brook and about 1½ miles above confluence of Souhegan with Merrimack River, at Merrimack, Hillsboro County.

DRAINAGE AREA.—168 square miles.

RECORDS AVAILABLE.—July 13, 1909, to September 30, 1917.

GAGES.—Gurley-printing water-stage recorder on left bank about 350 feet above the falls used since October 15, 1913. A vertical staff on left bank, 40 feet above the falls, was used from July 13, 1909, to April 11, 1911, when it was washed out. From April 12, 1911, to October 14, 1913, a chain gage attached to a tree on left bank 350 feet above the falls was used.

DISCHARGE MEASUREMENTS.—Made by wading below the falls or from cable one-half mile below gage.

CHANNEL AND CONTROL.—The channel opposite the gage is a pool in which velocity is very low. The control of this pool is a rock ledge at the head of Atherton Falls and is permanent.

EXTREMES OF DISCHARGE.—Maximum stage, from water-stage recorder, 7.51 feet at 5 p. m. March 28 (discharge, from extension of rating curve about 3,060 second-feet); minimum stage, from water-stage recorder, 2.06 feet at 9 p. m. September 23 (discharge, 26 second-feet).

1909–1917.—Maximum stage recorded, 9.6 feet, August 5, 1915 (discharge from extension of rating curve about 4,930 second-feet); minimum stage recorded 1.90 feet at 8 a. m. September 8, 1909 (discharge, 15 second-feet).

ICE.—Ice forms on control for short periods in the winter, slightly affecting stage-discharge relation.

REGULATION.—Flow affected by the operation of the mills at Milford about 8 miles above.

ACCURACY.—Stage-discharge relation permanent except when affected by ice for short periods. Rating curve well defined below 2,000 second-feet. Operation of water-stage recorder satisfactory. Daily discharge ascertained by applying rating table to the mean of 24 hourly gage heights with corrections for ice during winter. Records good.

Discharge measurements of Souhegan River at Merrimack, N. H., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Jan. 15	Hardin Thweatt	3.15	250
July 11	M. R. Stackpole	2.62	103

Daily discharge, in second-feet, of Souhegan River at Merrimack, N. H., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	94	60	303	105	128	890	1,040	331	288	264	72	242
2	88	64	260	115	115	665	1,170	692	253	210	70	168
3	88	68	180	120	105	496	950	720	228	222	60	148
4	70	68	155	118	82	380	860	488	270	219	57	125
5	72	52	160	128	98	311	802	447	242	172	49	122
6	68	58	165	192	84	278	802	860	256	168	43	96
7	60	86	145	319	96	274	1,230	802	264	140	30	90
8	49	84	122	319	100	270	1,300	585	281	106	54	76
9	42	68	118	292	100	284	950	492	299	104	55	68
10	55	66	112	240	100	315	720	474	222	116	64	51
11	49	62	130	200	80	295	585	402	295	105	66	64
12	43	48	140	170	92	315	550	363	920	105	51	74
13	41	44	140	150	96	367	510	363	1,010	110	45	68
14	46	76	112	150	110	400	483	398	590	110	48	57
15	40	104	98	246	110	367	420	323	416	110	49	64
16	32	106	76	331	105	367	438	278	355	110	70	43
17	51	96	74	278	110	460	411	260	860	115	104	37
18	46	82	80	216	108	488	406	239	1,860	120	198	44
19	41	60	86	185	112	470	434	225	980	148	130	45
20	80	66	82	158	120	367	460	198	610	165	90	46
21	160	86	86	122	122	355	692	198	447	162	102	52
22	112	66	120	125	116	416	638	198	355	120	90	44
23	92	76	175	120	110	520	560	270	288	104	76	32
24	90	160	240	130	112	920	452	501	260	125	72	35
25	74	250	170	130	128	1,720	375	355	323	108	76	45
26	70	135	140	128	162	1,680	335	292	274	118	70	36
27	68	108	130	120	339	1,640	339	228	236	116	57	39
28	62	116	120	108	1,100	2,570	474	239	207	106	68	42
29	80	108	110	112	......	2,100	420	319	188	70	72	46
30	39	116	105	116	......	1,470	367	515	274	66	295	36
31	55	......	100	130	......	1,100	......	371	......	82	375	......

NOTE.—Stage-discharge relation affected by ice Dec. 17–31, Jan. 1–3, 10–12, and Feb. 1–17. Discharge estimated July 11–17.

Monthly discharge of Souhegan River at Merrimack, N. H., for the year ending Sept. 30, 1917.

[Drainage area, 168 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	160	32	66.3	0.394	0.45
November	250	44	88.0	.524	.58
December	303	74	137	.815	.94
January	331	105	173	1.03	1.19
February	1,100	80	151	.900	.94
March	2,570	270	727	4.33	4.99
April	1,300	335	639	3.80	4.24
May	860	198	401	2.39	2.76
June	1,860	188	445	2.65	2.96
July	264	66	132	.786	.91
August	375	30	89.0	.530	.61
September	242	32	71.2	.423	.47
The year	2,570	30	260	1.55	21.04

SOUTH BRANCH OF NASHUA RIVER BASIN (WACHUSETT DRAINAGE BASIN) NEAR CLINTON, MASS.

LOCATION.—At Wachusett dam, near Clinton.

DRAINAGE AREA.—119 square miles 1896 to 1907; 118.19 square miles 1908–1913; 108.84 square miles 1914–1917.

RECORDS AVAILABLE.—July, 1896, to September 30, 1917.

REGULATION.—Flow affected by storage in Wachusett reservoir and other ponds. Beginning with 1897 the determinations of discharge have been corrected for gain or loss in the reservoir and ponds so that the record shows approximately the natural flow of the stream.

The yield per square mile is the yield of the drainage area including the water surfaces. For the years 1897 to 1902, inclusive, the water surface amounted to 2.2 per cent of the total area; 1903, 2.4 per cent; 1904, 3.6 per cent; 1905, 4.1 per cent; 1906, 5.1 per cent; 1907, 6.0 per cent; 1908–1915, 7.0 per cent.

COOPERATION.—Record furnished by the Metropolitan Water and Sewerage Board of Boston; rearranged to climatic year form by engineers of the Geological Survey.

Yield and rainfall in South Branch of Nashua River basin (Wachusett drainage basin) near Clinton, Mass., for the year ending Sept. 30, 1917.

[Drainage area, 108.84 square miles.] [a]

Month.	Total yield (million gallons).	Yield per square mile.		Run off.		Rainfall (inches).
		Million gallons per day.	Second-feet.	Depth on drainage area (inches.)	Per cent of rainfall.	
October	472.0	0.140	0.217	0.250	17.6	1.42
November	1,047.6	.321	.496	.554	17.6	3.15
December	1,551.5	.460	.712	.820	29.2	2.18
January	2,315.2	.686	1.062	1.224	36.3	3.37
February	2,792.8	.916	1.418	1.476	48.3	3.05
March	8,339.6	2.472	3.824	4.409	104.8	4.21
April	4,794.2	1.468	2.272	2.535	140.6	1.80
May	4,444.5	1.317	2.038	2.350	60.5	3.89
June	4,014.3	1.229	1.902	2.122	47.4	4.47
July	891.5	.264	.409	.471	38.8	1.22
August	1,043.5	.309	.479	.552	12.4	4.46
September	272.9	.084	.129	.144	12.0	1.20
The year	31,979.6	.805	1.245	16.907	49.1	34.42

Summary of yield and rainfall in South Branch of Nashua River basin (Wachusett drainage basin) near Clinton, Mass., for the years ending Sept. 30, 1897–1917.

[Drainage area, 108.84 square miles.] [a]

Month.	Total yield (million gallons).	Yield per square mile.		Run off.		Rainfall (inches).
		Million gallons per day.	Second-feet.	Depth on drainage area (inches.)	Per cent of rainfall.	
October	35,445.8	0.499	0.772	0.890	24.0	3.71
November	50,728.7	.739	1.143	1.275	34.2	3.73
December	80,202.5	1.128	1.745	2.012	52.5	3.83
January	85,767.6	1.210	1.872	2.158	58.8	3.66
February	89,356.9	1.387	2.146	2.234	59.1	3.78
March	180,560.9	2.548	3.942	4.544	110.5	4.11
April	146,653.1	2.139	3.309	3.692	99.5	3.71
May	85,250.7	1.203	1.861	2.145	63.3	3.39
June	54,147.2	.790	1.222	1.363	36.6	3.72
July	30,878.9	.436	.674	.777	19.0	4.10
August	30,353.5	.428	.663	.764	18.2	4.20
September	21,647.1	.316	.488	.545	16.0	3.42
The year	890,992.9	1.069	1.653	22.399	41.0	45.36

[a] Although the drainage area has been changed at different times, quantities in this table correspond to present drainage area.

SUDBURY RIVER AND LAKE COCHITUATE BASINS NEAR FRAMINGHAM AND COCHITUATE, MASS.

DRAINAGE AREA.—Area of Sudbury basin from 1875 to 1878, inclusive, was 77.8 square miles; 1879–80, 78.2 square miles; 1881–1917, 75.2 square miles. Area of Cochituate basin from 1863 to 1909, inclusive, was 18.87 square miles; 1910, 17.8 square miles; 1911 to 1917, 17.58 square miles.

RECORDS AVAILABLE.—Of Sudbury River, January, 1875, to September, 1917; of Lake Cochituate, January, 1863, to September, 1917. Sudbury River and Lake Cochituate have been studied by the engineers of the city of Boston, the State Board of Health of Massachusetts, and the Metropolitan Water and Sewerage Board; records of rainfall have been kept in the Sudbury basin since 1875 and in the Cochituate basin since 1852, but the latter are considered of doubtful accuracy previous to 1872.

REGULATION.—The greater part of the flow from these basins is controlled by storage reservoirs constructed by the city of Boston and the Metropolitan Water and Sewerage Board. Lake Cochituate, which drains into Sudbury River a short distance below Framingham, is controlled as a storage reservoir by the Metropolitan Waterworks. In the Sudbury River basin the water surfaces exposed to evaporation have been increased from time to time by the construction of additional storage reservoirs. From 1875 to 1878, inclusive, the water surface amounted to 1.9 per cent of the total area; from 1879 to 1884, to 3 per cent; 1885 to 1893, to 3.4 per cent; 1894 to 1897, to 3.9 per cent; 1898 and subsequent years, 6.5 per cent.

DETERMINATION OF DISCHARGE.—In determining the run-off of the Sudbury and Cochituate drainage areas, the water diverted for the municipal supply of Framingham, Natick, and Westboro, which discharge their sewage outside the basins, is taken into consideration; the results, however, are probably less accurate since the sewerage diversion works were constructed. The public water and sewerage works were installed in these towns as follows:

Dates of installation of water and sewerage works in Framingham, Natick, and Westboro.

Town.	Water supply.	Sewerage works.
Framingham	1875	1889
Natick	1874	1896
Westboro	1879	1892

Water from the Wachusett drainage area also passes into the reservoirs in the Sudbury basin and must be measured to determine the yield of the Sudbury basin; the small errors unavoidable in the measurement of large quantities of water decrease the accuracy of the determination of the Sudbury water supply during months of low yield for years subsequent to 1897.

COOPERATION.—Record furnished by the Metropolitan Water and Sewerage Board of Boston; form changed to climatic year by engineers of the Geological Survey.

Yield and rainfall in Sudbury River basin near Framingham, Mass., for the year ending Sept. 30, 1917.

[Drainage area, 75.2 square miles.]

Month.	Total yield (million gallons).	Yield per square mile.		Run-off.		Rainfall (inches).
		Million gallons per day.	Second-feet.	Depth on drainage area (inches.)	Per cent of rainfall.	
October	−12.2	−0.005	−0.008	−0.009	−0.6	1.49
November	247.3	.110	.170	.189	8.3	2.28
December	734.2	.315	.487	.562	17.4	3.22
January	1,188.2	.510	.789	.909	25.9	3.50
February	1,589.1	.755	1.168	1.216	45.5	2.68
March	5,148.5	2.209	3.417	3.940	79.4	4.96
April	3,169.5	1.405	2.174	2.425	100.5	2.41
May	3,440.4	1.476	2.283	2.632	53.4	4.93
June	2,354.8	1.044	1.615	1.802	42.7	4.28
July	99.5	.043	.066	.076	6.8	1.11
August	471.5	.202	.313	.361	5.6	6.40
September	130.5	.058	.090	.100	6.6	1.52
The year	18,561.3	.676	1.046	14.203	36.7	38.73

Summary of yield and rainfall in Sudbury River basin near Framingham, Mass., for the years ending Sept. 30, 1876–1917.

[Drainage area, 75.2 square miles.] [a]

Month.	Total yield (million gallons).	Yield per square mile.		Run-off.		Rainfall (inches).
		Million gallons per day.	Second-feet.	Depth on drainage area (inches.)	Per cent of rainfall.	
October	40,237.9	0.411	0.636	0.733	19.4	3.78
November	69,597.1	.735	1.137	1.269	34.1	3.72
December	93,868.4	.959	1.484	1.711	44.7	3.83
January	117,433.4	1.199	1.855	2.139	52.3	4.09
February	147,901.2	1.658	2.565	2.671	64.6	4.13
March	266,858.8	2.726	4.217	4.862	112.0	4.34
April	185,902.7	1.962	3.035	3.386	96.5	3.51
May	104,847.3	1.071	1.657	1.910	57.7	3.31
June	46,318.4	.489	.756	.844	28.4	2.97
July	17,364.3	.177	.274	.316	8.7	3.63
August	23,416.8	.239	.370	.427	10.9	3.92
September	20,161.8	.213	.330	.368	11.3	3.25
The year	1,133,908.1	.983	1,521	20.636	46.4	44.48

[a] Although the drainage area has been changed at different times, quantities in this table correspond to the present area.

Yield and rainfall in Lake Cochituate basin near Cochituate, Mass., for the year ending Sept. 30, 1917.

[Drainage area, 17.58 square miles.]

Month.	Total yield (million gallons).	Yield per square mile.		Run off.		Rainfall (inches).
		Million gallons per day.	Second-feet.	Depth on drainage area (inches.)	Per cent of rainfall.	
October	36.3	0.067	0.103	0.12	9.3	1.28
November	72.1	.137	.215	.24	10.8	2.15
December	151.6	.278	.430	.50	15.6	3.18
January	269.1	.494	.764	.88	26.9	3.25
February	392.9	.798	1.235	1.29	45.8	2.81
March	1,090.8	2.002	3.097	3.57	74.1	4.82
April	677.8	1,285	1.988	2.22	83.1	2.67
May	769.5	1.412	2.185	2.52	51.5	4.89
June	575.7	1.092	1.689	1.88	43.5	4.33
July	94.3	.173	.268	.31	30.3	1.02
August	120.6	.221	.342	.39	6.8	5.79
September	48.2	.091	.141	.16	8.9	1.77
The year	4,298.9	.670	1.036	14.08	37.0	38.02

Summary of yield and rainfall in Lake Cochituate basin near Cochituate, Mass., for the years ending Sept. 30, 1864–1917.

[Drainage area, 17.58 square miles.][a]

Month.	Total yield (million gallons).	Yield per square mile.		Run off.		Rainfall (inches).
		Million gallons per day.	Second-feet.	Depth on drainage area (inches.)	Per cent of rainfall.	
October	15,211.7	0.517	0.800	0.922	22.9	4.02
November	20,983.3	.737	1.140	1.272	32.5	3.91
December	26,462.8	.899	1.391	1.604	44.6	3.60
January	32,276.6	1.097	1.697	1.957	50.6	3.87
February	40,276.1	1.502	2.324	2.420	61.7	3.92
March	63,093.1	2.144	3.317	3.825	88.7	4.31
April	47,259.1	1.660	2.568	2.865	82.8	3.46
May	28,550.5	.970	1.501	1.731	48.2	3.59
June	13,398.0	.471	.729	.813	26.8	3.03
July	7,735.6	.263	.407	.469	12.6	3.72
August	11,157.6	.379	.586	.676	16.4	4.12
September	10,880.0	.382	.591	.659	18.9	3.48
The year	317,284.4	.916	1.417	19.213	42.7	45.03

[a] Although the drainage area has been changed at different times, quantities in this table correspond to the present area.

CONNECTICUT RIVER BASIN.

CONNECTICUT RIVER AT FIRST LAKE, NEAR PITTSBURG, N. H.

Location.—At outlet of First Lake, 5 miles northeast of Pittsburg, Coos County.

Drainage area.—81.4 square miles. (From surveys by engineers of the Connecticut Valley Lumber Co.)

Records available.—April 1 to September 30, 1917.

Gages.—Inclined staff on right bank about one-fourth mile below the outlet dam; installed in November, 1917, and used in determining sluice gate ratings; scales on gate frames indicate amount of sluice gate openings; staff gage in lake above dam.

Discharge measurements.—Made from log bridge 1 mile below the gage, by wading, or from cable 200 feet above gage.

Channel and control.—Bed rough, with rock bottom. Control for river gage is rock ledge extending completely across the stream with about 3 feet of fall immediately below.

Computation of discharge.—Discharge through 3 sluice gates, 6 feet, 8 feet, and 20 feet in width, determined from gate ratings based on current-meter measurements and comparative readings of river gage; theoretical rating used for a part of the discharge through the 20-foot gate and lower leaf of 6-foot and 8-foot gates, under conditions not covered by the current-meter measurements. Discharge through one water wheel, used when slasher was in operation, determined from figures of water-wheel efficiency and power output.

Ice.—Little effect from ice on the control section for river gage; formation of ice in the sluice materially changes conditions at gates.

Regulation.—About 4.1 billion cubic feet of storage has been developed in lakes and ponds above gage; records of monthly discharge have been corrected for effect of storage in First Lake but not for effect of storage in lakes tributary to First Lake.

Accuracy.—Discharge through the gates possibly affected by ice April 1–7. Rating curves well defined for middle and upper leaves of the 6-foot and 8-foot gates; theoretical ratings for the 20-foot gate for high stages of the lake and for lower leaves of 6-foot and 8-foot gates, not completely checked by current-meter measurements. Daily discharge ascertained by applying rating tables to records of gate openings, giving due consideration to times of opening and closing gates and changes in gate settings. Records good, except for few days in April, when accuracy of results may have been affected by ice.

No discharge measurements were made prior to September 30, 1917.

Daily gage height, in feet, of First Lake near Pittsburg, N. H., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	15.1	12.25	9.2	6.1	3.3	2.4	3.05	9.45	22.4	22.4	20.95	21.55
2	14.9	12.15	9.35	6.0	3.2	2.4	3.1	9.25	22.7	22.45	20.95	21.55
3	14.6	11.8	9.45	5.95	3.1	2.45	3.2	9.5	22.6	22.4	21.25	21.55
4	14.3	11.55	9.5	5.75	2.95	2.4	3.25	10.4	22.75	22.3	21.3	21.6
5	13.9	11.3	9.45	5.7	2.85	2.4	3.35	10.65	22.95	22.3	21.4	21.65
6	13.45	11.2	9.4	5.6	2.75	2.35	3.4	11.0	22.7	22.3	21.4	21.5
7	13.3	11.05	9.35	5.5	2.7	2.3	3.5	11.3	22.55	22.15	21.35	21.45
8	12.9	10.95	9.3	5.4	2.65	2.25	3.65	11.6	22.4	22.05	21.25	21.35
9	12.1	10.85	9.25	5.35	2.55	2.3	3.8	12.0	22.2	22.15	21.2	21.2
10	12.35	10.75	9.15	5.3	2.5	2.35	3.85	12.25	22.05	22.05	21.55	21.1
11	12.3	10.5	8.95	5.2	2.45	2.4	3.9	12.95	22.15	21.95	21.95	20.9
12	12.1	10.25	8.75	5.1	2.4	2.4	4.0	13.55	22.3	21.95	21.85	20.8
13	12.0	10.2	8.4	5.05	2.3	2.5	4.1	14.1	22.5	22.0	21.8	20.6
14	12.1	10.15	8.3	4.95	2.25	2.45	4.15	14.4	22.5	21.95	21.7	20.6
15	12.1	10.15	8.25	4.9	2.2	2.4	4.2	14.9	22.4	21.85	21.75	20.55
16	12.1	9.9	8.1	4.85	2.15	2.4	4.25	15.6	22.4	21.8	21.95	......
17	12.2	9.75	7.9	4.8	2.1	2.45	4.45	15.95	22.3	21.7	22.2	20.2
18	12.4	9.55	7.7	4.75	2.15	2.45	4.45	16.3	22.95	21.6	22.75	20.45
19	12.55	9.4	7.55	4.7	2.25	2.45	4.45	16.8	23.85	21.5	23.3	20.95
20	12.8	9.25	7.45	4.6	2.3	2.5	4.6	17.35	23.4	21.5	23.2	20.95
21	12.95	9.15	7.25	4.55	2.35	2.5	4.9	18.45	23.25	21.4	23.2	21.25
22	12.8	9.05	7.1	4.5	2.4	2.5	5.35	19.15	22.95	21.45	23.3	21.25
23	12.8	9.05	7.1	4.45	2.35	2.45	5.8	19.75	22.7	21.5	23.0	21.1
24	12.7	9.1	6.95	4.4	2.35	2.45	6.25	20.35	22.35	21.4	22.5	20.9
25	12.65	8.95	6.55	4.2	2.3	2.5	6.55	20.55	22.25	21.3	22.6	20.9
26	12.75	8.75	6.75	4.1	2.3	2.55	6.85	21.4	22.25	21.25	22.35	20.75
27	12.75	8.8	6.55	3.95	2.35	2.6	7.05	21.95	22.15	21.2	22.4	20.75
28	12.55	8.55	6.45	3.55	2.45	2.8	7.25	22.1	22.1	21.1	22.25	20.55
29	12.75	8.55	6.35	3.45	......	2.9	7.5	22.3	22.05	21.05	22.35	20.55
30	12.75	8.55	6.25	3.35	......	2.9	7.85	22.45	22.15	21.0	22.05	20.15
31	12.4	......	6.15	3.4	......	3.0	......	22.5	......	21.0	21.95	......

Daily discharge, in second-feet, of Connecticut River at First Lake, near Pittsburg, N. H., for the period Apr. 1 to Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May	June.	July.	Aug.	Sept.
1	299	6	414	359	133	244	16	3	14	382	195	147	396
2	305	7	556	344	172	241	17	3	15	372	190	207	307
3	315	7	673	327	86	181	18	3	16	820	185	97	178
4	322	8	921	285	165	226	19	3	17	1,290	174	305	65
5	329	8	940	241	179	266	20	4	18	1,210	172	517	57
6	278	8	875	238	163	240	21	4	22	1,170	163	367	106
7	124	27	787	229	174	234	22	4	24	904	99	542	265
8	3	9	617	226	153	227	23	4	26	731	180	490	278
9	3	10	459	214	183	196	24	5	26	429	159	306	248
10	3	10	415	221	102	219	25	5	30	358	205	418	335
11	3	11	315	219	231	196	26	5	102	374	175	377	393
12	3	11	367	211	213	167	27	5	287	205	155	382	448
13	3	12	550	219	194	131	28	5	306	121	146	278	463
14	3	12	626	210	174	137	29	5	376	285	140	391	422
15	3	13	443	205	151	240	30	6	482	333	136	344	196
							31	......	501	......	134	309	......

Monthly discharge of Connecticut River at First Lake, near Pittsburg, N. H., for the period Apr. 1 to Sept. 30, 1917.

[Drainage area 81.4 square miles.]

Month.	Observed discharge (second-feet).			Gain or loss in storage at First Lake (millions of cubic feet).	Discharge corrected for storage (second-feet).		Run-off (depth in inches in drainage area).
	Maximum.	Minimum.	Mean.		Mean.	Per square mile.	
April	329	3	68.6	+ 448	242	2.97	3.31
May	501	6	78.2	+1,655	696	8.55	9.86
June	1,290	121	601	− 44.5	584	7.17	8.00
July	359	99	205	− 144	151	1.86	2.14
August	542	86	260	+ 119	304	3.73	4.30
September	463	57	244	− 223	158	1.94	2.16

CONNECTICUT RIVER AT ORFORD, N. H.

LOCATION.—At covered highway bridge between Orford, N. H., and Fairlee, Vt., approximately 10 miles downstream (by river) from mouth of Waits River.

DRAINAGE AREA.—3,100 square miles.

RECORDS AVAILABLE.—August 6, 1900, to September 30, 1917.

GAGES.—Inclined staff on left bank 25 feet below bridge; chain attached to upstream side of bridge is also used at certain stages.

DISCHARGE MEASUREMENTS.—Open-water measurements made from cable.

CHANNEL AND CONTROL.—Channel wide and deep, with gravelly bottom; control for high stages is probably at the dam at Wilder, 20 miles below station.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 21.3 feet at 7 a. m. and 6 p. m. April 24 (discharge, 29,500 second-feet); minimum stage recorded, 4.6 feet several times in September (discharge, 1,720 second-feet). Minimum discharge of 1,550 second-feet occurred February 25, when the stage-discharge relation was affected by ice.

1900–1917: Maximum stage recorded, 33.4 feet at 12 noon March 28, 1913 (discharge, by extension of rating curve, about 57,300 second-feet); minimum 24-hour discharge, 288 second-feet, September 28, 1908.

ICE.—Stage-discharge relation seriously affected by ice December to March; ice cover usually remains in place throughout winter.

REGULATION.—About 4.1 billion cubic feet of storage has been developed in First Lake and in lakes and ponds tributary to First Lake; natural flow not seriously affected by use of stored water prior to September 30, 1916.

ACCURACY.—Stage-discharge relation affected at times by use of flashboards at Wilder dam and, during the winter, by ice. Several rating curves adjusted to condition of flashboards were used during the year. Gage read to tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table with corrections for ice during the winter. Records good, except for September, for which they are fair.

Discharge measurements of Connecticut River at Orford, N. H., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
[illegible]	Hardin Thomas	[illegible]	[illegible]	Feb. 23	H. H. [illegible]	[illegible]	[illegible]
4	do	[illegible]	2,[illegible]	23	do	[illegible]	[illegible]
9	[illegible] Pierce	[illegible]	[illegible]	Mar. 4	do	[illegible]	[illegible]
Nov. [illegible]	Hardin Thomas	[illegible]	[illegible]	4	do	[illegible]	[illegible]
Dec. [illegible]	do	[illegible]	[illegible]	July 29	Hardin Thomas	[illegible]	[illegible]
[illegible]	do	[illegible]	[illegible]	Sept. [illegible]	M. R. [illegible]	[illegible]	2,[illegible]
Jan. [illegible]	do	[illegible]	2,[illegible]	23	do	[illegible]	2,[illegible]

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Connecticut River at Orford, N. H., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	[illegible]	2,440	14,700	2,670	2,450	2,950	22,100	14,200	4,900	8,400	2,200	5,640
2	[illegible]	[illegible]	[illegible]	2,550	2,230	[illegible]	26,300	[illegible]	7,400	9,420	2,110	5,520
3	[illegible]	[illegible]	[illegible]	2,550	[illegible]	2,600	26,700	[illegible]	7,400	8,780	2,110	4,920
4	[illegible]	[illegible]	[illegible]	2,450	2,400	2,620	22,400	14,400	5,400	7,640	1,850	4,300
5	[illegible]	[illegible]	5,300	2,550	2,300	2,260	[illegible]	[illegible]	5,900	5,400	2,950	3,300
6	[illegible]	[illegible]	[illegible]	2,400	[illegible]	[illegible]	[illegible]	[illegible]	8,140	4,540	2,450	3,300
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7,150	4,150	2,190	2,670
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4,620	3,400	2,110	2,570
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3,470	5,420	2,950	2,110	2,730
10	[illegible]	[illegible]	4,220	2,160	2,150	1,790	13,300	8,400	8,300	2,850	2,540	2,430
11	[illegible]	[illegible]	[illegible]	[illegible]	2,400	[illegible]	9,920	9,670	9,470	2,400	3,900	2,430
12	[illegible]	[illegible]	[illegible]	[illegible]	1,800	[illegible]	[illegible]	13,770	17,300	2,730	4,580	2,430
13	[illegible]	[illegible]	[illegible]	[illegible]	1,550	[illegible]	[illegible]	12,300	25,400	3,270	3,400	2,280
14	[illegible]	[illegible]	[illegible]	[illegible]	1,730	[illegible]	[illegible]	13,300	20,100	3,400	3,050	2,140
15	[illegible]	[illegible]	4,300	2,550	1,700	[illegible]	[illegible]	13,300	16,300	3,270	2,670	2,000
16	[illegible]	2,780	[illegible]	[illegible]	1,450	[illegible]	[illegible]	11,300	12,300	3,520	2,380	2,000
17	[illegible]	[illegible]	[illegible]	[illegible]	1,550	[illegible]	[illegible]	[illegible]	17,100	4,200	3,140	1,880
18	[illegible]	[illegible]	[illegible]	[illegible]	1,400	[illegible]	[illegible]	9,580	20,700	3,350	6,130	1,880
19	[illegible]	[illegible]	[illegible]	[illegible]	1,550	[illegible]	[illegible]	8,310	27,100	2,950	8,920	1,720
20	[illegible]	2,540	3,550	[illegible]	1,450	1,730	[illegible]	8,980	22,500	2,550	8,600	1,720
21	[illegible]	[illegible]	[illegible]	[illegible]	1,450	[illegible]	[illegible]	11,990	20,580	3,050	7,400	1,720
22	[illegible]	[illegible]	[illegible]	[illegible]	1,400	[illegible]	25,300	11,300	16,900	3,220	8,520	2,350
23	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	13,700	3,400	9,700	2,300
24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	29,500	19,100	10,700	3,300	7,440	2,430
25	[illegible]	[illegible]	3,550	2,300	1,550	3,300	25,100	9,330	9,600	3,400	9,180	2,430
26	[illegible]	[illegible]	3,450	2,300	1,400	[illegible]	[illegible]	9,470	8,300	2,950	9,570	2,430
27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8,930	7,150	2,470	8,100	2,140
28	[illegible]	[illegible]	[illegible]	[illegible]	1,550	[illegible]	[illegible]	7,900	6,170	2,110	6,130	1,900
29	[illegible]	[illegible]	[illegible]	[illegible]	....	[illegible]	[illegible]	7,190	5,300	2,110	4,580	1,720
30	[illegible]	[illegible]	[illegible]	[illegible]	....	[illegible]	[illegible]	7,190	5,990	2,030	4,250	1,930
31	[illegible]	....	[illegible]	2,450	....	[illegible]	....	7,190	....	2,250	5,040	....

NOTE.—Stage-discharge relation affected by ice Nov. 13-30, and Dec. 15 to Mar. 27; discharge determined from [illegible] gage heights, discharge measurements, weather records, and comparisons of similar studies of near-by streams.

Monthly discharge of Connecticut River at Orford, N. H., for the year ending Sept. 30, 1917.

[Drainage area, 3,100 square miles.]

Month.	Observed discharge (second-feet).			Gain or loss in storage at First Lake (millions of cubic feet).	Discharge corrected for storage (second-feet).		Run-off (depth in inches in drainage area).
	Maximum.	Minimum.	Mean.		Mean.	Per square mile.	
October	5,920	2,150	3,310	− 329	3,190	1.03	1.19
November	7,810	2,500	3,600	− 371	3,460	1.12	1.25
December	17,800	2,450	6,190	− 265	6,090	1.96	2.26
January	3,650	2,100	2,700	− 249	2,610	.842	.97
February	2,450	1,550	1,850	− 91.1	1,810	.584	.61
March	26,500	1,700	5,200	+ 56.1	5,220	1.68	1.94
April	29,500	7,320	16,900	+ 448	17,100	5.52	6.16
May	15,900	7,180	10,500	+1,655	11,100	3.58	4.13
June	27,100	5,200	12,000	− 44.5	12,000	3.87	4.32
July	9,620	2,030	3,900	− 144	3,850	1.24	1.43
August	9,700	1,950	4,870	+ 119	4,910	1.58	1.82
September	5,640	1,720	2,670	− 223	2,580	.832	.93
The year	29,500	1,550	6,150	....	6,170	1.99	27.01

CONNECTICUT RIVER AT SUNDERLAND, MASS.

LOCATION.—At five-span steel highway bridge at Sunderland, Franklin County, on road leading to South Deerfield, about 18 miles in a direct line and 24 miles by river above dam at Holyoke. Deerfield River enters the Connecticut from the west about 8 miles above the station.

DRAINAGE AREA.—8,000 square miles.

RECORDS AVAILABLE.—March 31, 1904, to September 30, 1917. From 1880 to 1899 records were obtained at Holyyoke, Mass.

GAGES.—Chain on downstream side of bridge; read by V. Lawer. Sanborn water-stage recorder on left bank, installed September 3, 1916.

DISCHARGE MEASUREMENTS.—Made from highway bridge.

CHANNEL AND CONTROL.—Channel deep; bottom of coarse gravel and alluvial deposits. Control at low stages not well defined but practically permanent; at high stages the control is at the crest of the dam at Holyoke.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 20.0 feet at 7 a. m. March 30 (discharge, 63,700 second-feet); minimum stage recorded, 0.8 foot at 7. a. m. September 24 (discharge, 880 second-feet).

1904–1917: Maximum stage recorded, 30.7 feet during the night of March 28, 1913, determined by leveling from flood marks (discharge, computed from extension of rating curve, about 108,000 second-feet[1]); minimum stage recorded, 0.6 foot September 28, 1914 (discharge, computed from extension of rating curve, about 700 second-feet).

ICE.—The river usually freezes over early in the winter but the ice is likely to break up at times of sudden rises in stage and at those times it occasionally forms ice jams at Northampton, 10 miles below the station, causing several feet of backwater at the gage.

REGULATION.—Distribution of flow affected by operation of power plants at Turners Falls, Mass., and by regulation of Deerfield River. The effect of the regulation is shown by low water at the gage on Sundays and Mondays. Storage in Somerset reservoir and First Lake has very little effect on the run-off as observed at Sunderland.

[1] Supersedes figures previously published.

Accuracy.—Stage-discharge relation practically permanent except when affected by ice. Rating curve well defined between 1,[illegible] and [illegible] second-feet. Chain gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table with corrections for ice during the winter. Records good except for extremely high and low stages and for times of ice effect, for which they are fair.

Discharge measurements of Connecticut River at Sunderland, Mass., during the year ending Sept. 30, 1917.

[Made by A. H. [illegible].]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. [illegible]	[illegible]	[illegible]	Feb. [illegible]	a4.35	[illegible]
Jan. [illegible]	a1.12	[illegible]	Mar. 3	a5.44	[illegible]

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Connecticut River at Sunderland, Mass., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	21,700	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6,270	[illegible]	[illegible]
12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3,330	[illegible]
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6,270	[illegible]	[illegible]
14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7,000	6,350	[illegible]
15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6,000	6,400	[illegible]
17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7,900	6,400	[illegible]
18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8,100	7,400	[illegible]
19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17,900	[illegible]	7,000	10,700	[illegible]
20	[illegible]	[illegible]	[illegible]	[illegible]	4,300	[illegible]	[illegible]	[illegible]	[illegible]	6,950	10,700	[illegible]
21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17,900	[illegible]	6,400	12,000	4,200
22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7,900	13,300	[illegible]
23	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	20,300	[illegible]	5,200	12,000	[illegible]
24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	22,900	22,500	6,400	15,000	2,200
25	[illegible]	[illegible]	[illegible]	[illegible]	2,200	[illegible]	[illegible]	22,100	24,000	6,950	14,000	[illegible]
26	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	20,300	22,500	6,720	11,300	3,170
27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19,900	15,200	7,150	16,000	3,330
28	[illegible]	[illegible]	[illegible]	[illegible]	14,000	[illegible]	[illegible]	17,000	16,700	5,530	12,000	3,330
29	[illegible]	[illegible]	[illegible]	5,300	......	[illegible]	[illegible]	19,900	14,700	3,000	[illegible]	3,000
30	[illegible]	[illegible]	[illegible]	[illegible]	......	[illegible]	[illegible]	25,000	11,000	3,300	10,700	1,900
31	6,960	......	[illegible]	[illegible]	......	[illegible]	......	[illegible]	......	4,200	11,700	......

NOTE.—Stage-discharge relation affected by ice Dec. 16–Mar. 24; discharge during this period determined from study of gage-height graph, discharge measurements, weather records, and comparison with similar study for Connecticut River at Orford, and Turners Falls.

Monthly discharge of Connecticut River at Sunderland, Mass., for the year ending Sept. 30, 1917.

[Drainage area, 8,000 square miles.]

Month.	Observed discharge (second-feet).			Gain or loss in storage (millions of cubic feet).		Discharge corrected for storage (second feet).		Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	First Lake.	Somerset Reservoir.	Mean.	Per square mile.	
October	14,300	3,020	7,010	− 329	−369	6,750	0.844	0.97
November	22,500	3,330	8,180	− 371	+ 29	8,050	1.01	1.13
December	30,800	5,410	14,000	− 265	−130	13,900	1.74	2.01
January	12,300	4,210	7,930	− 249	−246	7,740	.968	1.12
February	14,000	1,960	4,640	− 91.1	−448	4,420	.552	.57
March	61,300	5,200	17,200	+ 56.1	+153	17,300	2.16	2.49
April	59,700	18,100	39,300	+ 448	+541	39,700	4.96	5.53
May	34,600	15,700	24,500	+1,655	+464	25,300	3.16	3.64
June	48,600	11,000	26,400	− 44.5	+268	26,500	3.31	3.69
July	17,400	3,020	7,930	− 144	− 71	7,850	.981	1.13
August	16,000	2,080	8,020	+ 119	− 59	8,040	1.00	1.15
September	11,300	1,620	5,180	− 223	−438	4,920	.615	.69
The year	61,300	1,620	14,200	....	....	14,200	1.78	24.12

PASSUMPSIC RIVER AT PIERCE'S MILLS, NEAR ST. JOHNSBURY, VT.

LOCATION.—At suspension footbridge just below Pierce's mills, about 2 miles below mouth of Sheldon Branch, 4 miles above mouth of Moose River, and 5 miles north of St. Johnsbury, Caledonia County.

DRAINAGE AREA.—237 square miles.

RECORDS AVAILABLE.—May 26, 1909, to September 30, 1917.

GAGE.—Staff in two sections; low-water section, a vertical staff bolted to ledge just above bridge; high-water section, an inclined staff bolted to ledge below bridge; read by Joseph Cox and W. I. Cox.

DISCHARGE MEASUREMENTS.—Made from footbridge or by wading below the bridge.

CHANNEL AND CONTROL.—Bed composed of ledge rock partly covered with gravel and alluvial deposits. At high stages the control is probably at the dam near Centervale.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.5 feet at 8 p. m. November 30 (discharge, by extension of rating curve, about 3,630 second-feet); minimum stage recorded, 1.55 feet at 5 p. m. August 8 and 7 a. m. August 9 (discharge, 141 second-feet); minimum discharge, 100 second-feet, March 20 (stage-discharge relation affected by ice).

1909–1917: Maximum stage recorded, 14.8 feet during the night of March 27, 1913, determined by leveling from flood marks (discharge not computed); minimum stage recorded, zero flow at various times when water is being held back by mills.

ICE.—River freezes over at the control; stage-discharge relation seriously affected; ice jams occasionally form below the gage.

REGULATION.—A small diurnal fluctuation is caused by the operation of Pierce's mills, just above the station, and by other mills farther upstream. The effect of the diurnal fluctuation was studied by means of a portable automatic gage from August 16 to September 11, 1914. Although the results obtained from twice-a-day gage heights were found to be occasionally in error for individual days, mean discharge for the period determined from twice-a-day gage heights was found to be identical with that obtained from hourly gage heights.

[illegible]—Stage-discharge relation practically permanent, but many individual discharge measurements show a large percentage of error, probably due to fluctuation in stage during the measurement. Rating curve fairly well defined below [illegible] second-feet. [illegible] Daily discharge ascertained by applying mean daily gage height to rating table with corrections [illegible] during the winter. [illegible]

Discharge measurements of Passumpsic River at Pierce's mills, near St. Johnsbury, Vt., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. [illegible]	Hardin Thompson	[illegible]	[illegible]	July [illegible]	W. R. [illegible]	1.4[illegible]	[illegible]
Mar. [illegible]	[illegible]	[illegible]		[illegible]	Hardin Thompson	1.6	[illegible]
Apr. [illegible]	do	[illegible]	[illegible]				

[illegible] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Passumpsic River at Pierce's mills, St. Johnsbury, Vt., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	300	470	202	405
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	300	1,300	175	530
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	300	600	164	400
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	590	420	175	330
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	575	300	175	225
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	340	300	132	305
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	280	300	132	300
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	430	280	132	300
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	670	280	400	245
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	470	[illegible]	300	245	670	280
11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	400	570	830	216	330	300
12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	850	[illegible]	340	230	330
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	400	[illegible]	[illegible]	330	175	230
14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	440	[illegible]	640	275	144	302
15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	400	730	500	730	190	300
16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	440	400	500	300	530	302
17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	400	500	530	225	1,500	302
18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	530	1,400	245	1,510	175
19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	530	790	275	670	175
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	670	500	300	530	216
21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2,090	600	530	500	1,090	300
22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	500	400	530	600	245
23	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	500	300	420	420	302
24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	225	[illegible]	[illegible]	530	250	420	302
25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	330	[illegible]	[illegible]	500	230	1,000	300
26	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	530	300	202	500	164
27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	490	300	175	300	164
28	[illegible]	[illegible]	[illegible]	[illegible]	440	[illegible]	950	405	305	152	305	175
29	[illegible]	[illegible]	[illegible]	[illegible]	.....	[illegible]	[illegible]	300	500	152	530	175
30	[illegible]	[illegible]	[illegible]	[illegible]	.....	[illegible]	1,130	500	1,300	216	500	330
31	[illegible]	.....	[illegible]	[illegible]	.....	350	.....	405	.....	305	500	.....

NOTE.—Stage-discharge relation affected by ice Dec. 14 to Mar. 28; discharge determined from study of gage-height graph, discharge measurements, weather records, and comparison with similar studies for near-by streams.

Monthly discharge of Passumpsic River at Pierce's mills, near St. Johnsbury, Vt., for the year ending Sept. 30, 1917.

[Drainage area, 237 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	870	189	300	1.27	1.46
November	1,660	202	408	1.72	1.92
December	1,560	200	414	1.75	2.02
January	520	215	253	1.07	1.23
February	440	190	217	.916	.95
March	3,140	100	470	1.98	2.28
April	2,480	600	1,240	5.23	5.84
May	1,220	390	687	2.90	3.34
June	2,000	290	622	2.62	2.92
July	1,000	152	369	1.56	1.80
August	1,560	152	482	2.03	2.34
September	530	164	259	1.09	1.22
The year	3,140	100	477	2.01	27.32

WHITE RIVER AT WEST HARTFORD, VT

Location. About 500 feet above highway bridge in West Hartford, Windsor County and 7 miles above mouth of river.

Drainage area.—687 square miles (measured on topographic maps, and Post Route map of Vermont, edition of 1915).

Records available.—June 9, 1915, to September 30, 1917.

Gage.—Inclined staff on left bank; read by F. P. Morse.

Discharge measurements.—Made from cable 1,500 feet below the gage or by wading.

Channel and control.—Channel wide and .of fairly uniform cross section at measuring section. Bed covered with gravel and small boulders. Control formed by rock ledge 100 feet below the gage; well defined.

Extremes of discharge.—Maximum stage recorded during year, 11.1 feet at 6 p. m. June 12 (discharge, by extension of rating curve, about 11,700 second-feet); minimum stage recorded, 2.40 feet at 6 p. m. September 27 (discharge, by extension of rating curve, about 36 second-feet).

1915–1917: Maximum stage recorded June 12, 1917; minimum stage recorded, 2.33 feet at 6 a. m. August 29, 1916 (discharge, by extension of rating curve,[1] about 26 second-feet). The highwater of March 27, 1913, reached a stage of 18.9 feet, as determined from reference point on scale platform opposite gage (discharge not determined).

Ice.—River freezes over at the gage; control usually remains partly open, although ice on the rocks and along the shore affects the stage-discharge relation.

Regulation.—There are several power plants on the main stream and tributaries above the station, the nearest being that of the Vermont Copper Co., at Sharon; when this plant is in operation it causes some diurnal fluctuation in discharge at low stages. The effect of power plants farther upstream is eliminated by the large amount of pondage at Sharon.

Accuracy.—Stage-discharge relation practically permanent except when affected by ice. Rating curve fairly well defined between 150 and 5,000 second-feet. Staff gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table with corrections for ice during the winter. Records good.

[1] Revised, and supersedes minimum published in Water-Supply paper 431.

Monthly discharge of White River at West Hartford, Vt., for the year ending Sept. 30, 1917.

[Drainage area, 687 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	960	74	311	0.453	0.52
November	3,320	205	614	.894	1.00
December	2,880	240	794	1.16	1.34
January	1,550	280	646	.940	1.08
February	1,400	300	392	.571	.59
March	8,700	340	1,430	2.08	2.40
April	7,530	1,880	3,680	5.36	5.98
May	3,170	1,380	2,000	2.91	3.36
June	10,100	820	1,990	2.90	3.24
July	1,120	240	505	.735	.85
August	820	166	314	.457	.53
September	365	72	197	.287	.32
The year	10,100	72	1,070	1.56	21.21

ASHUELOT RIVER AT HINSDALE, N. H.

Location.—At lower steel highway bridge, about a quarter of a mile below dam of Fisk Paper Co., and 1¼ miles above mouth of river, at Hinsdale, Cheshire County.

Drainage area.—440 square miles.

Records available.—February 22, 1907, to December 31, 1909, and July 11, 1914, to September 30, 1917.

Gage.—Chain gage on downstream side of bridge; read by T. W. Golden.

Discharge measurements.—Made from bridge.

Channel and control.—Bed covered with coarse gravel and boulders. Control is a short distance below gage and is practically permanent.

Extremes of discharge.—Maximum stage recorded during year, 7.25 feet at 4 p. m. March 29 (discharge, from extension of rating curve, about 4,820 second-feet); minimum stage recorded, 2 10 feet at 8 a. m. August 29 (discharge, from extension of rating curve, about 12 second-feet.)

1914–1917.—Maximum stage recorded, 7.5 feet at 5 p. m. February 26, 1915 (discharge, from extension of rating curve, about 5,190 second-feet); minimum stage recorded, 2.0 feet at 4 p. m. October 4, 1914 (discharge, from extension of rating curve, about 10 second-feet).

Ice.—Stage discharge relation affected for short periods by ice which forms below bridge on control.

Regulation.—The mills immediately above station are operated continuously except for Sundays and holidays, but cause little fluctuation in stage. Storage in the mill ponds above affects distribution of flow. The effect of power regulation was studied by a temporary installation of water-stage recorder during July and August, 1917.

Accuracy.—Stage-discharge relation practically permanent except when affected by ice. Rating curve fairly well defined below 4,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table with corrections for ice during the winter. Records good.

Monthly discharge of Ashuelot River at Hinsdale, N. H., for the year ending Sept. 30, 1917.

[Drainage area, 440 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,000	231	437	0.993	1.14
November	730	247	399	.909	1.01
December	1,670	460	780	1.77	2.04
January	1,100	660	866	1.97	2.27
February	1,910	660	844	1.92	2.00
March	4,590	590	1,530	3.48	4.01
April	3,140	400	1,490	3.39	3.78
May	1,320	400	795	1.81	2.09
June	3,280	520	1,270	2.89	3.22
July	520	30	280	.636	.73
August	1,000	68	321	.729	.84
September	191	54	132	.300	.33
The year	4,590	30	761	1.73	23.46

MILLERS RIVER NEAR WINCHENDON, MASS.

LOCATION.—At steel highway bridge known locally as Nolan's bridge, half a mile below mouth of Sip Pond Brook and 2 miles west of Winchendon, Worcester County.

DRAINAGE AREA.—80 square miles (measured on topographic maps).

RECORDS AVAILABLE.—June 5, 1916, to September 30, 1917.

GAGE.—Stevens continuous water-stage recorder on right bank just below bridge; installed July 4, 1917. Chain gage on downstream side of bridge June 5, 1916, to February 28, 1917. Foxboro water-stage recorder June 5 to July 3, 1917. Gages read by Arthur Lehman and Franklin Epps.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed covered with gravel and alluvial deposits. Control for low and medium stages is gravel bar about 200 feet below gage; shifts occasionally.

EXTREMES OF DISCHARGE.—Maximum stage during year ending September 30, 1917, occurred during period of unrecorded gage height; minimum stage, from water-stage recorder, 2.60 feet at 8.30 a. m. August 13 (discharge, about 6 second-feet).

1916–17: Maximum stage recorded, 5.53 feet at 6 p. m. June 19, 1916 (discharge about 481 second-feet[1]); minimum stage recorded August 13, 1917.

ICE.—Stage-discharge relation seriously affected by ice. Complete ice cover usually remains intact throughout the winter. Owing to large diurnal fluctuation caused by operation of power plants above, water frequently overflows the ice cover.

REGULATION.—Distribution of flow is affected by operation of power plants at Winchendon and by storage in Lake Monomonac and other reservoirs.

ACCURACY.—Stage-discharge relation subject to changes on account of shifts in low water control; also affected by ice. Rating curve for 1917 is well defined between 20 and 250 second-feet and fairly well defined between 250 and 600 second-feet. Daily gage height June 5, 1916, to February 28, 1917, is mean of two readings per day, to hundredths, on chain gage; gage heights June 5 to July 3, 1917, is mean of 24 gage heights per day from Foxboro water-stage recorder. Daily discharge June 5, 1916, to July 3, 1917, ascertained by applying mean daily gage height to rating table with corrections for ice during the winter; discharge July 4 to September 30, 1917, determined by use of discharge integrator. Records for periods during which water-stage recorders were in operation are good; those for other periods are fair.

[1] Revised determination; supersedes that published in Water-Supply Paper 431.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	June.	July.	Aug.	Sept.
1916–17.									
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
23	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
26	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
28	[illegible]	[illegible]	[illegible]	[illegible]	240	[illegible]	[illegible]	72	[illegible]
29	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
30	[illegible]	101	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
31	[illegible]		[illegible]	[illegible]			[illegible]	[illegible]	

NOTE.—1916: Revised determinations based on data obtained during 1917; supersede those published in Water-Supply Paper [illegible].

1917: Stage-discharge relation affected by ice Dec. [illegible], 1916, and Jan. [illegible] to Feb. 28, 1917; discharge determined from study of gage-height graph, discharge measurements, weather records, and comparison with study for Millers River at Erving. No gage-height record Mar. 1 to June 4. Discharge Sept. [illegible] by comparison with record of flow of Sip Pond Brook near Winchendon.

onthly discharge of Millers River near Winchendon, Mass., for the years ending Sept. 30, 1916–17.

[Drainage area, 80.0 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1916.					
une 5–30	383	89	204	2.55	2.46
uly	312	14	100	1.25	1.44
ugust	109	18	57.8	.722	.83
eptember	300	21	95.1	1.19	1.33
1916–17.					
ctober	129	16	59.2	.740	.85
ovember	105	16	53.8	.672	.75
ecember	218	31	80.3	1.00	1.15
anuary	170	18	78.9	.986	1.14
ebruary	240	18	61.4	.768	.80
une 5–30	475	45	176	2.20	2.13
uly	118	17	72.8	.910	1.05
ugust	340	14	108	1.35	1.56
eptember	305	15	69.2	.865	.97

NOTE.—Determination for 1916 revised by means of data obtained during 1917; supersede those published in Water-Supply Paper 431.

MILLERS RIVER AT ERVING, MASS.

LOCATION.—At downstream end of chair factory at Erving, Franklin County, about 8 miles above confluence of Millers River with Connecticut River and below all important tributaries.

DRAINAGE AREA.—372 square miles (measured on topographic maps).

RECORDS AVAILABLE.—August 1, 1914, to September 30, 1917.

GAGES.—Barrett & Lawrence 7-day hydrochronograph installed February 3, 1916, to replace Barrett & Lawrence gage installed July 1, 1915. Vertical staff attached to downstream end of factory, used August 1, 1914, to July 1, 1915, and at times when hydrochronographs were out of order. All gages at same site and datum; read by C. H. Gary and E. F. Bancroft.

DISCHARGE MEASUREMENTS.—Made from cable near gage or by wading.

CHANNEL AND CONTROL.—Bed covered with coarse gravel and boulders. Control is a short distance below the gage and is practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 5.32 feet at 6 p. m. March 28 (discharge, 4,820 second-feet); minimum stage, from water-stage recorder, 0.87 foot at 3.30 p. m. October 29 (discharge practically zero).

1914–1917: Maximum stage recorded, 5.6 feet at 4 p. m. February 25, 1915 (discharge, 5,160 second-feet [1]); minimum discharge, practically zero at various times during 1915, and at 3.30 p. m. October 29, 1916, when water was held back by dams above the gage.

ICE.—River freezes over below the gage at various times during the winter; ice considerably broken by rising and falling stages due to operation of power-plants.

REGULATION.—Distribution of flow affected by operation of various power plants and storage reservoirs above the station.

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[1] Supersedes maximum published in Water-Supply Paper 415.

Discharge measurements of Millers River near Winchendon, Mass., during the year [cut off at edge]
Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.
		Feet.	*Sec.-ft.*			*Feet.*
Oct. 13	C. H. Pierce	a 3.67	118	June 4	Hardin Thweatt	4.12
Jan. 17	Hardin Thweatt	a 5.16	221	11	.....do	4.41
Feb. 20	H. H. Khachadoorian	4.45	108	12	.....do	4.77
Apr. 3	Hardin Thweatt	5.34	462	15	C. H. Pierce	3.90
4	.....do	5.16	388	18	Hardin Thweatt	5.67
June 4	.....do	4.12	220	18	M. R. Stackpole	5.58

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Millers River near Winchendon, Mass., for the [cut off at edge]
ending Sept. 30, 1916–1917.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.
1916.					1916.			
1	....	54	87	58	16	192	15	73
2	....	14	82	47	17	314	78	50
3	....	133	80	25	18	246	76	52
4	....	97	101	21	19	383	67	27
5	135	205	37	43	20	280	51	26
6	125	123	28	68	21	170	48	33
7	123	135	76	64	22	272	39	37
8	89	89	85	55	23	200	40	45
9	125	35	76	40	24	95	111	70
10	133	97	74	21	25	97	53	29
11	185	178	58	45	26	272	82	41
12	336	105	56	61	27	212	178	18
13	334	99	31	67	28	182	312	48
14	300	93	53	54	29	137	212	39
15	242	64	109	125	30	117	79	73
					31	....	150	97

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	June.	July.	Aug.
1916–17.								
1	111	58	105	54	50	....	107	56
2	129	45	218	84	25	....	103	47
3	101	31	53	125	45	....	103	44
4	82	34	55	135	18	....	38	39
5	62	16	78	135	40	45	63	34
6	70	31	53	115	62	76	66	37
7	54	58	53	27	78	129	58	62
8	29	61	82	93	55	125	17	59
9	[illegible]	53	109	125	62	79	47	76
10	[illegible]	53	31	125	35	61	73	88
11	[illegible]	[illegible]	47	121	25	131	77	64
12	[illegible]	[illegible]	53	105	55	248	114	19
13	[illegible]	[illegible]	76	85	55	274	61	42
14	[illegible]	[illegible]	51	50	70	252	90	63
15	[illegible]	[illegible]	76	125	62	175	17	65
16	[illegible]	[illegible]	73	170	145	125	66	104
17	[illegible]	[illegible]	30	78	105	284	63	210
18	[illegible]	[illegible]	[illegible]	70	25	475	94	315
19	[illegible]	[illegible]	[illegible]	70	95	405	82	174
20	[illegible]	[illegible]	[illegible]	70	85	327	100	[illegible]
21	[illegible]	[illegible]	[illegible]	25	40	246	70	[illegible]
22	[illegible]	[illegible]	[illegible]	40	22	148	13	[illegible]
23	[illegible]	[illegible]	[illegible]	78	45	115	[illegible]	[illegible]
24	[illegible]	[illegible]	[illegible]	45	25	100	[illegible]	[illegible]
25	[illegible]	[illegible]	[illegible]	50	16	180	[illegible]	[illegible]
26	[illegible]	[illegible]	[illegible]	45	62	[illegible]	[illegible]	[illegible]
27	[illegible]	[illegible]	[illegible]	35	78	[illegible]	[illegible]	[illegible]
28	[illegible]	[illegible]	[illegible]	18	240	[illegible]	[illegible]	[illegible]
29	21	[illegible]	[illegible]	40	....	[illegible]	[illegible]	[illegible]
30	36	[illegible]	[illegible]	13	....	[illegible]	[illegible]	[illegible]
31	55	[illegible]	[illegible]	[illegible]	....	[illegible]	[illegible]	[illegible]

NOTE... minatio... ...
Water-... ...n affe... ..., 1916, and Ja...
1917: ...ht gr... ...urements, weathe...
mined ... ...ght record Mar. 1 to Ju...
simi... ...d Brook near Winchende...
esti...

Monthly discharge of Millers River near Winchendon, Mass., for the years [illegible] 30, 1916–17.

[Drainage area, 80.0 square miles.]

Month.	Discharge in second-feet.				[illegible]
	Maximum.	Minimum.	Mean.	Per square mile.	
1916.					
June 5-30	383	[illegible]	[illegible]	[illegible]	[illegible]
July	312	[illegible]	[illegible]	[illegible]	[illegible]
August	109	[illegible]	[illegible]	[illegible]	[illegible]
September	300	[illegible]	[illegible]	[illegible]	[illegible]
1916–17.					
October	129	[illegible]	[illegible]	[illegible]	[illegible]
November	105	[illegible]	[illegible]	[illegible]	[illegible]
December	218	[illegible]	[illegible]	[illegible]	[illegible]
January	170	[illegible]	[illegible]	[illegible]	[illegible]
February	240	[illegible]	[illegible]	[illegible]	[illegible]
June 5-30	475	[illegible]	[illegible]	[illegible]	[illegible]
July	118	[illegible]	[illegible]	[illegible]	[illegible]
August	240	[illegible]	[illegible]	[illegible]	[illegible]
September	305	[illegible]	[illegible]	[illegible]	[illegible]

NOTE.—Determination for 1916 revised by means of data [illegible] published in Water-Supply Paper 431.

MILLERS RIVER AT ERVING, MASS.

LOCATION.—At downstream end of chair factory at Erving, [illegible] 8 miles above confluence of Millers River with Connecticut River [illegible] important tributaries.

DRAINAGE AREA.—372 square miles (measured on topographic map).

RECORDS AVAILABLE.—August 1, 1914, to September 30, [illegible] of

GAGES.—Barrett & Lawrence 7-day hydrochronograph [illegible] ed. to replace Barrett & Lawrence gage installed [illegible] stage to downstream end of factory, used August [illegible] when hydrochronographs were out of order. [illegible] clearly de- read by C. H. Gary and E. F. Bancroft. [illegible] d staff gage

DISCHARGE MEASUREMENTS.—Made from [illegible]

CHANNEL AND CONTROL.—Bed covered with [illegible], 5.21 feet (on in- [illegible] ance below the gage [illegible] of rating curve, 294

EXTREMES OF DISCHARGE.—Maximum stage [illegible] occurred February 18, [illegible] 6 p. m. March 28 (discharge, [illegible] minimum open-water dis- [illegible] stage recorder, 0.8[illegible] [illegible], inclined gage, 2.01 feet).

[illegible] 17; minimum stage, from water- [illegible] 17: Maximum stage [illegible], 1916 (discharge, from extension [illegible] 5,160 second-feet [illegible] ring 1915, and at [illegible] rably affected by operation of mills at [illegible] above the gage [illegible] rly Pond and Sip Pond.

[illegible] freezes over [illegible] occasionally at lower gage but appar- [illegible] ly broken by [illegible] urves used to June 26 fairly well defined [illegible] June 27 to September 30, well defined

[illegible] ON.—Distribution [illegible] ned staff read to hundredths twice daily. [illegible] reservoirs [illegible] rs satisfactory. Daily discharge October 1 [illegible] ying mean daily gage height from water-stage [illegible] r 13 to June 26, by applying to rating table [illegible] nclined gage with corrections for ice during the [illegible], by use of discharge integrator. Records good.

[1] Super[illegible]

ACCURACY.—Stage-discharge relation practically permanent except when affected by ice. Rating curve well defined below 4,000 second-feet. Staff gage read to hundredths twice daily. Daily discharge ascertained by use of discharge integrator except for periods when continuous gage-height record was not obtained. For these periods the staff gage records were used with corrections as determined by various comparisons with the water-stage recorder. Records good except for times of ice effect, for which they are fair.

Discharge measurements of Millers River at Erving, Mass., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 8	A. H. Davison	3.03	805	Jan. 30	Hardin Thweatt	a 2.72	344
19	Hardin Thweatt	a 2.38	334	Feb. 23	H. H. Khachadoorian	a 3.76	300
Jan. 20	....do	a 3.55	710	Sept. 18	M. R. Stackpole	2.21	319

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Millers River at Erving, Mass., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	700	250	1,080	440	390	1,550	2,350	880	780	560	260	1,140
2	650	330	1,080	310	360	1,500	2,200	960	700	630	210	800
3	600	295	800	380	320	1,250	2,050	1,140	610	490	240	570
4	510	255	820	390	310	1,100	1,900	1,020	640	320	220	490
5	420	155	650	460	300	1,000	1,720	1,060	520	410	82	430
6	410	340	600	630	320	960	1,660	1,200	620	375	250	370
7	350	310	570	550	290	880	1,840	1,360	680	360	210	320
8	265	330	520	670	300	780	1,920	1,160	840	255	160	315
9	310	320	410	740	300	780	1,780	1,140	850	315	240	315
10	300	290	470	650	320	720	1,580	1,020	710	275	620	295
11	300	255	450	600	250	610	1,340	860	780	365	520	315
12	230	182	490	490	290	730	1,220	820	1,280	450	280	290
13	345	275	530	460	290	870	1,260	680	1,520	530	375	270
14	410	230	480	640	280	920	1,020	740	1,300	410	240	275
15	90	415	430	1,150	270	770	840	750	1,180	330	270	240
16	315	190	400	960	300	810	900	720	930	395	280	120
17	280	470	400	940	300	880	890	610	930	340	340	275
18	300	300	380	700	200	850	880	560	1,400	470	740	235
19	310	95	370	520	320	1,020	800	460	1,380	470	800	250
20	415	325	370	490	300	860	980	465	1,240	435	700	245
21	490	300	360	500	320	830	1,160	570	880	420	510	255
22	330	260	390	450	200	820	1,080	445	780	360	540	275
23	330	330	680	520	280	1,020	1,140	670	600	260	440	96
24	375	690	560	480	270	1,660	1,100	850	430	315	360	270
25	330	800	530	450	300	2,250	1,040	880	680	390	345	215
26	350	590	810	470	450	2,800	770	740	600	420	260	200
27	330	620	650	500	800	3,000	930	570	550	395	275	185
28	390	570	520	380	1,200	4,350	890	450	540	360	325	240
29	115	540	530	370	....	4,500	810	850	410	260	350	245
30	290	650	490	340	....	3,450	760	1,080	540	295	880	63
31	280	....	450	370	....	2,600	....	980	....	210	1,290	....

NOTE.—Stage-discharge relation affected by ice Dec. 16–22, Dec. 30–Jan. 1, and Jan. 11–Mar. 10; discharge for these periods determined from study of gage-height graph, discharge measurements, weather records, and comparison with similar study for Millers River near Winchendon. Discharge determined from mean of two gage heights daily, Nov. 13–18, Dec. 9, Jan. 13, 19–22, 24, Feb. 3, 5–17, 22–24, 28; Mar. 1–6, 20, and Apr. 12–14.

Monthly discharge of Millers River at Erving, Mass., for the year ending Sept. 30, 1917.

[Drainage area, 372 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	700	90	359	0.965	1.11
November	800	95	365	.981	1.09
December	1,080	360	557	1.50	1.73
January	1,150	310	548	1.47	1.70
February	1,200	200	351	.944	.98
March	4,500	610	1,490	4.01	4.62
April	2,350	760	1,290	3.47	3.87
May	1,360	445	829	2.23	2.57
June	1,520	410	830	2.23	2.49
July	630	210	383	1.03	1.19
August	1,280	82	407	1.09	1.26
September	1,140	63	320	.860	.96
The year	4,500	63	646	1.74	23.57

SIP POND BROOK NEAR WINCHENDON, MASS.

Location.—About 500 feet above highway bridge, a quarter of a mile below Massachusetts-New Hampshire State line, 1½ miles below outlet of Sip Pond, and 3 miles northwest of Winchendon, Worcester County.

Drainage area.—18.8 square miles (measured on topographic maps).

Records available.—May 29, 1916, to September 30, 1917.

Gages.—Gurley 7-day water-stage recorder, installed June 26, 1917, and vertical staff gage installed June 9, 1917, on left bank 500 feet above highway bridge. Inclined staff gage on right bank 50 feet above highway bridge used May 29 to June 29 and December 13, 1916, to June 26, 1917; Stevens 8-day water-stage recorder at same site and datum used June 30 to December 12, 1916. Gages read by W. G. Greenall and Hazel Greenall. All gages at same datum but owing to slope of stream readings on present gage are higher than those on gages previously used.

Discharge measurements.—Made from footbridge 15 feet below Gurley water-stage recorder or by wading.

Channel and control.—Bed rough; covered with boulders. Control clearly defined. Considerable aquatic vegetation in channel below inclined staff gage during summer months.

Extremes of discharge.—Maximum stage recorded during year, 5.21 feet (on inclined gage) at 6 p. m. March 28 (discharge, from extension of rating curve, 294 second-feet); minimum discharge, about 6 second-feet, occurred February 18, when stage-discharge relation was affected by ice; minimum open-water discharge, 7.2 second-feet at 7 a. m. October 28 (stage, inclined gage, 2.01 feet).

1916–17: Maximum stage recorded March 28, 1917; minimum stage, from water-stage recorder, 1.88 feet at 7 a. m. September 15, 1916 (discharge, from extension of rating curve, 5 second-feet).

Regulation.—Distribution of flow is considerably affected by operation of mills at State Line, N. H., and by storage in Pearly Pond and Sip Pond.

Accuracy.—Stage-discharge relation changed occasionally at lower gage but apparently permanent at upper one. Rating curves used to June 26 fairly well defined between 9 and 130 second-feet; from June 27 to September 30, well defined between 9 and 100 second-feet. Inclined staff read to hundredths twice daily. Operation of both water-stage recorders satisfactory. Daily discharge October 1 to December 12 ascertained by applying mean daily gage height from water-stage recorder to rating table; December 13 to June 26, by applying to rating table mean of two readings per day on inclined gage with corrections for ice during the winter; June 27 to September 30, by use of discharge integrator. Records good.

Discharge measurements of Sip Pond Brook near Winchendon, Mass., during the year ending Sept. 30, 1917.

Date.		Made by—	Gage height. New location.	Gage height. Original location.	Discharge.	Date.		Made by—	Gage height. New location.	Gage height. Original location.	Discharge.
			Feet.	*Feet.*	*Sec.-ft.*				*Feet.*	*Feet.*	*Sec.-ft.*
Oct.	[illegible]	C. H. Pierce	----	2.[illegible]	[illegible]	June	3	Hardin Thweatt	----	2.46	22.5
Nov.	[illegible]	Hardin Thweatt	----	2.[illegible]	[illegible]		3	do	----	2.50	25.6
Dec.	2[illegible]	do	----	2.7[illegible]	36.1		9	do	6.47	2.98	48.4
Jan.	[illegible]	[illegible]	----	3.[illegible]	58.4		12	do	----	3.35	b64
Feb.	2[illegible]	do	----	a4.2[illegible]	2[illegible].1		13	C. H. Pierce	6.[illegible]	3.45	80
Apr.	3	Hardin Thweatt	----	3.4[illegible]	[illegible]		2[illegible]	do	6.55	3.05	53
	3	do	----	3.[illegible]	[illegible]	July	5	Hardin Thweatt	5.[illegible]	2.45	23.7
							[illegible]	M. R. Stackpole	5.46	2.06	11.7

a Stage-discharge relation affected by ice.
b Results uncertain.

Daily discharge, in second-feet, of Sip Pond Brook near Winchendon, Mass., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	[illegible]	[illegible]	36	38	[illegible]	42	132	45	36	19	14	100
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	48	128	46	34	24	14	76
3	3[illegible]	[illegible]	40	38	[illegible]	40	122	56	35	23	14	65
4	[illegible]	[illegible]	44	[illegible]	9	52	1[illegible]	52	34	20	14	51
5	32	[illegible]	38	35	15	46	148	61	30	18	9	38
6	25	29	[illegible]	42	[illegible]	52	128	63	32	18	15	35
7	36	[illegible]	35	36	[illegible]	44	122	62	35	15	11	33
8	[illegible]	[illegible]	38	32	[illegible]	43	[illegible]	55	35	11	13	28
9	[illegible]	36	32	35	[illegible]	43	11[illegible]	54	40	15	13	28
10	22	23	[illegible]	32	13	42	96	51	37	19	14	27
11	32	[illegible]	22	38	[illegible]	36	83	47	41	22	14	25
12	32	9	32	34	13	30	74	48	57	18	10	22
13	[illegible]	[illegible]	38	32	[illegible]	37	60	42	74	18	15	21
14	[illegible]	[illegible]	35	[illegible]	[illegible]	35	60	45	68	16	14	18
15	9	[illegible]	38	32	[illegible]	30	58	42	54	10	16	16
16	[illegible]	32	29	45	15	36	54	35	44	15	45	12
17	[illegible]	32	35	5[illegible]	15	30	44	30	68	17	136	14
18	[illegible]	[illegible]	35	40	[illegible]	31	42	27	86	16	176	15
19	1[illegible]	[illegible]	29	30	16	41	42	35	77	21	135	14
20	24	[illegible]	31	32	22	53	46	19	56	13	70	15
21	24	[illegible]	25	30	17	40	68	36	45	16	63	14
22	13	[illegible]	30	17	14	37	58	24	38	10	55	13
23	22	32	28	22	17	36	70	25	34	14	43	11
24	22	30	14	20	15	51	60	30	29	22	30	14
25	19	32	19	19	7	96	55	34	37	24	32	14
26	14	19	28	18	30	117	51	34	32	23	28	13
27	17	30	29	15	40	146	54	29	27	28	28	14
28	14	31	30	9	46	200	46	35	24	20	24	15
29	9	28	30	16	......	232	46	35	21	13	35	15
30	17	32	29	20	......	272	48	36	23	17	112	18
31	17	......	18	21	......	182	......	38	......	17	128	......

NOTE.—Stage-discharge relation affected by ice Dec. 26 to Jan. 5, Jan. 11-15, and Jan. 19-Mar. 9; discharge determined from study of gage-height graph, observer's notes, and weather records. Discharge estimated July 4, 14, and Aug. 9-12.

Ionthly discharge of Sip Pond Brook near Winchendon, Mass., for the year ending Sept. 30, 1917.

[Drainage area, 18.8 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
ctober	61	8	21.8	1.16	1.34
ovember	32	9	19.2	1.02	1.14
ecember	56	12	28.8	1.53	1.76
nuary	57	9	27.6	1.47	1.70
ebruary	60	7	18.4	.979	1.02
arch	290	26	74.7	3.97	4.58
pril	124	42	74.8	3.98	4.44
ay	63	19	41.2	2.19	2.52
me	86	21	42.6	2.27	2.53
ily	24	10	17.7	.941	1.08
ugust	176	9	43.5	2.31	2.66
eptember	100	10	26.1	1.39	1.55
The year	290	7	36.5	1.94	26.32

PRIEST BROOK NEAR WINCHENDON, MASS.

ᴏᴄᴀᴛɪᴏɴ.—At highway bridge 3 miles above confluence of Priest Brook with Millers River and 3½ miles west of Winchendon, Worcester County.

ʀᴀɪɴᴀɢᴇ ᴀʀᴇᴀ.—18.8 square miles (measured on topographic maps).

ʀᴇᴄᴏʀᴅs ᴀᴠᴀɪʟᴀʙʟᴇ.—May 25, 1916, to September 30, 1917.

ᴀɢᴇ.—Sloping staff on left bank 200 feet below highway bridge; read by R. D. Hutchinson.

ɪsᴄʜᴀʀɢᴇ ᴍᴇᴀsᴜʀᴇᴍᴇɴᴛs.—Made from highway bridge or by wading.

ʜᴀɴɴᴇʟ ᴀɴᴅ ᴄᴏɴᴛʀᴏʟ.—Channel above station is straight; section fairly uniform; gravel bottom. Control formed by the foundation of an old dam 30 feet below gage; permanent.

Exᴛʀᴇᴍᴇs ᴏғ ᴅɪsᴄʜᴀʀɢᴇ.—1916–17: Maximum stage recorded, 4.88 feet at 7 a. m. March 28 and 29, 1917 (discharge, 306 second-feet); minimum stage recorded, 2.30 feet several times in August, 1917 (discharge, by extension of rating curve, about 1.5 second-feet).

Iᴄᴇ.—Brook freezes over at gage, and on control; stage-discharge relation somewhat affected.

Rᴇɢᴜʟᴀᴛɪᴏɴ.—Flow not appreciably affected by regulation.

Aᴄᴄᴜʀᴀᴄʏ.—Stage-discharge relation practically permanent, except when affected by ice. Rating curve well defined between 2 and 180 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table with corrections for ice during the winter. Records good.

Discharge measurements of Priest Brook near Winchendon, Mass., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 22	Hardin Thweatt	a 3.00	17.8	June 8	C. H. Pierce	3.37	49.0
Jan. 17	...do	a 3.53	45.8	8	Hardin Thweatt	3.40	50
Feb. 20	H. H. Khachadoorian	a 2.85	12.3	Aug. 2	M. R. Stackpole	2.37	2.58
Apr. 3	Hardin Thweatt	4.04	138	Oct. 13	.....do	2.91	15.4

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Priest Brook near Winchendon, Mass., for the years ending Sept. 30, 1916–17.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1916.												
1									26	18	20	6
2									24	17	22	7
3									16	37	18	2
4									22	50	20	2
5									20	47	19	2
6									24	15	19	4
7									34	35	8.6	11
8									30	37	4.8	5
9									27	27	25	10
10									30	21	27	3
11									41	27	17	2
12									37	21	15	7
13									50	17	13	4
14									43	19	14	2
15									33	17	18	6
16									29	14	11	129
17									41	15	9.5	65
18									73	15	8.0	40
19									77	15	4.8	52
20									81	11	14	42
21									75	15	5	35
22									65	17	3.0	32
23									68	22	9.5	38
24									30	19	22	95
25								35	33	19	11	65
26								25	53	30	11	49
27								24	48	38	3.0	40
28								18	32	15	13	32
29								30	26	77	15	32
30								27	21	43	9.8	59
31								35	......	35	9.2	......
1917.												
1	54	23	52	12	12	96	150	29	35	13	2.4	132
2	40	18	71	17	12	93	150	50	29	11	2.0	99
3	33	18	38	13	12	62	150	52	26	11	6.5	68
4	20	18	45	20	13	57	132	46	29	11	2.5	45
5	25	19	41	14	10	40	125	46	23	12	2.0	38
6	22	21	48	32	19	49	112	56	29	16	1.6	32
7	27	17	41	48	10	35	150	61	32	8.0	1.7	21
8	17	14	49	35	9.2	29	150	58	44	9.5	2.0	23
9	18	16	48	35	8.4	32	112	37	60	9.5	2.8	20
10	14	16	46	39	8.0	34	91	36	50	9.8	32	19
11	14	16	38	36	8.0	30	92	37	58	13	7.4	18
12	14	13	27	32	8.0	30	56	38	44	23	2.2	9.2
13	12	13	24	19	7.1	32	70	30	122	21	6.8	9.5
14	13	15	21	25	6.5	30	56	33	102	11	8.3	17
15	13	19	20	31	6.5	32	48	27	71	7.1	14	11
16	13	19	20	64	6.8	33	46	22	56	7.4	41	8.3
17	15	18	16	48	8.0	36	43	22	67	13	150	7.7
18	19	16	14	35	8.0	42	46	22	82	15	130	13
19	13	13	14	29	7.1	44	33	20	91	15	46	8.0
20	32	13	13	24	12	39	42	16	67	15	91	11
21	32	22	14	19	7.7	35	61	17	36	13	58	8.6
22	25	17	22	17	5.3	35	38	21	24	9.2	36	8.0
23	23	13	29	16	10	39	60	28	22	8.0	51	8.0
24	28	42	28	15	12	81	52	39	22	9.5	38	7.5
25	23	61	21	11	15	168	42	34	27	27	23	7.0
26	21	58	25	10	14	178	26	24	23	16	19	6.5
27	17	34	27	18	31	226	28	19	20	13	17	6.5
28	16	38	27	12	54	299	35	19	26	8.9	8.6	2.9
29	19	29	26	12	......	288	32	58	22	5.3	29	2.8
30	15	24	22	15	......	246	29	57	30	4.6	206	2.5
31	15	......	21	16	......	168	......	42	......	3.4	159	......

NOTE.—1916: Revised determinations based on data obtained in 1917; supersede those published in Water-Supply Paper 431.

1917: Stage-discharge relations affected by ice Dec. 13–29, and Jan. 12–Feb. 27, 1917; discharge determined from study of gage-height graph, discharge measurements, and weather records. Discharge estimated, Sept. 23–26.

Monthly discharge of Priest Brook near Winchendon, Mass., for the years ending Sept. 30, 1916–17.

[Drainage area, 18.8 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1916.					
May 25–31	35	18	26.7	1.42	0.37
June	81	16	41.2	2.19	2.44
July	150	11	31.3	1.66	1.91
August	29	3.0	14.2	.755	.87
September	129	2.0	30.0	1.60	1.78
1916–17.					
October	54	12	21.4	1.14	1.31
November	82	13	23.6	1.26	1.41
December	71	13	30.1	1.60	1.84
January	64	10	24.9	1.32	1.52
February	54	5.3	11.8	.628	.65
March	299	29	84.1	4.47	5.15
April	150	26	74.9	3.98	4.44
May	61	16	35.6	1.89	2.18
June	122	20	47.3	2.52	2.81
July	27	3.4	11.9	.633	.73
August	206	1.6	39.9	2.12	2.44
September	132	2.5	22.3	1.19	1.33
The year	299	1.6	35.8	1.90	25.81

NOTE.—Determinations for 1916 revised by means of data obtained during 1917; supersede those published in Water Supply-Paper 431.

OTTER RIVER NEAR GARDNER, MASS.

LOCATION.—At concrete arch bridge just above outlet of Wilder and Kneeland brooks, about a mile west of Gardner, Worcester County.

DRAINAGE AREA.—20 square miles (measured on topographic maps).

RECORDS AVAILABLE.—June 28, 1916, to September 30, 1917, when station was discontinued.

GAGE.—Vertical staff bolted to downstream side of right abutment of highway bridge; read by Alfred Cavalier.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Growth of aquatic vegetation in channel during summer months seriously affects stage-discharge relation.

EXTREMES OF DISCHARGE: Maximum stage during periods covered by records, 3.60 feet at 6 p. m. March 28, 1917 (discharge, 189 second-feet); minimum stage recorded, about −0.4 foot several times in October, 1917 (discharge not determined).

ICE.—Stage-discharge relation seriously affected by ice; river freezes over.

REGULATION.—Operation of a filter plant a quarter of a mile above the gage causes occasional fluctuations in discharge.

ACCURACY.—Stage-discharge relation seriously affected by ice and by aquatic vegetation. Frequent discharge measurements required. Standard rating curve fairly well defined. Gage read to hundredths twice daily. Daily discharge determined by shifting-control method, adjusted gage heights being applied to rating table for standard curve. Records fair.

[illegible] River near Gardner, Mass., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	Sec.-ft.			Feet.	Sec.-ft.
Oct. [illegible]	C. H. Pierce	[illegible]	[illegible]	June 24	C. H. Pierce	2.12	71
Nov. [illegible]	Hardin Thorndike	[illegible]	[illegible]	[illegible]	Hardin Thorndike	[illegible]	34.4
Dec. [illegible]	do	a [illegible]	[illegible]	[illegible]	M. R. Stackpole	[illegible]	34.8
Jan. [illegible]	do	a [illegible]	[illegible]	Aug. [illegible]	do	[illegible]	15.6
Feb. [illegible]	[illegible]	a [illegible]	[illegible]	Sept. [illegible]	do	[illegible]	6.7
Apr. [illegible]	Hardin Thorndike	[illegible]	[illegible]	[illegible]	do	—.[illegible]	6.4
[illegible]	do	[illegible]	[illegible]	25	do	—.[illegible]	5.7
June [illegible]	do	[illegible]	[illegible]				

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of [illegible] River near Gardner, Mass., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	35	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	31	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	45	25	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	45	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	31	[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	15	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	13	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	14	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	64	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	71	[illegible]	44	[illegible]	35	[illegible]	[illegible]
14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17
17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	18
18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	34	[illegible]	[illegible]	[illegible]	11
19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	64	34	[illegible]	7.9
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	44	[illegible]	[illegible]	[illegible]	[illegible]	8.2
21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	33	47	[illegible]	[illegible]	8.4
22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	35	44	25	[illegible]	10
23	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7.9
24	[illegible]	35	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	31	6.8
25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	34	[illegible]	[illegible]	[illegible]	[illegible]	8.0
26	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6.3
27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	43	[illegible]	19	[illegible]	5.1
28	[illegible]	44	[illegible]	[illegible]	[illegible]	[illegible]	54	[illegible]	33	[illegible]	13	5.2
29	[illegible]	[illegible]	[illegible]	[illegible]	......	[illegible]	[illegible]	52	[illegible]	19	[illegible]	5.2
30	[illegible]	[illegible]	[illegible]	[illegible]	......	[illegible]	[illegible]	54	[illegible]	17	[illegible]	5.0
31	[illegible]	......	[illegible]	[illegible]	......	[illegible]	......	[illegible]	......	15	[illegible]	......

NOTE.—Stage-discharge relation affected by ice Dec. [illegible], Dec. [illegible]-Jan. 4, and Jan. [illegible]-Feb. 26, by [illegible] in the [illegible] Oct. [illegible]-Nov. [illegible], Mar. 25-Apr. 16, and May 1-Sept. [illegible]. Daily discharge determined from study of gage-height graph, discharge measurements, and weather records.

Monthly discharge of Otter River near Gardner, Mass., for the year ending Sept. 30, 1917.

[Drainage area, 20.0 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	27	4.0	10.4	0.520	0.60
November	52	8.1	18.6	.930	1.04
December	52	7.9	29.6	1.48	1.71
January	58	7.6	27.8	1.39	1.60
February	96	6.2	20.5	1.02	1.06
March	185	60	87.2	4.36	5.03
April	125	40	70.8	3.54	3.95
May	64	32	46.4	2.32	2.68
June	76	32	47.9	2.40	2.68
July	37	13	24.6	1.23	1.42
August	49	13	28.9	1.44	1.66
September	39	5.0	18.6	.930	1.04
The year	185	4.0	36.0	1.80	24.47

EAST BRANCH OF TULLY RIVER NEAR ATHOL, MASS.

LOCATION.—At highway bridge half a mile below mouth of Lawrence Brook and 3½ miles north of Athol, Worcester County.

DRAINAGE AREA.—50.2 square miles (measured on topographic maps).

RECORDS AVAILABLE.—June 13, 1916, to September 30, 1917.

GAGE.—Vertical staff on downstream side of right abutment; read by W. A. Thompson.

DISCHARGE MEASUREMENTS.—Made from highway bridge or by wading.

CHANNEL AND CONTROL.—Two channels under bridge, one channel above; about 200 feet below the gage the channel is divided by an island. Control sections are formed by rocks and boulders in the two channels; probably permanent.

EXTREMES OF DISCHARGE.—1916–17: Maximum stage recorded, 3.76 feet at 1 p. m. March 28, 1917 (discharge, 780 second-feet); minimum stage recorded, 0.30 foot at 6 p. m. August 8 and 7 a. m. August 9, 1917 (discharge, 6.0 second-feet).

ICE.—Ice forms along banks; stage-discharge relation affected for short periods.

DIVERSIONS.—About half a mile below station water is diverted through a canal into Packard Pond; a discharge measurement made June 14, 1917, showed 13.0 second-feet diverted through canal.

REGULATION.—Flow not seriously affected by regulation.

ACCURACY.—Stage-discharge relation permanent except for short periods when affected by ice. Rating curve well defined between 10 and 300 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table with corrections for ice during the winter. Records good.

Discharge measurements of East Branch of Tully River near Athol, Mass., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 8	Hardin Thweatt	1.22	44.0	Apr. 5	Hardin Thweatt	2.54	279
Dec. 20	.....do	1.28	46.3	June 14	C. H. Pierce	2.38	226
Jan. 19	.....do	1.84	118	Aug. 2	M. R. Stackpole	.48	9.2

Daily discharge, in second-feet, of East Branch of Tully River near Athol, Mass., for the years ending Sept. 30, 1916 and 1917.

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1916.												
1										35	105	18
2										42	75	22
3										39	42	17
4										52	40	15
5										52	35	14
6										55	32	15
7										57	35	17
8										51	35	17
9										51	32	19
10										35	42	14
11										51	40	12
12										44	42	11
13									161	35	30	11
14									142	40	42	19
15									128	45	37	15
16									188	32	35	282
17									215	32	34	209
18									223	26	18	187
19									204	22	15	167
20									203	32	14	119
21									213	16	14	90
22									172	30	12	71
23									138	45	14	77
24									122	53	65	120
25									95	45	75	140
26									130	51	59	112
27									125	105	40	77
28									104	47	43	70
29									84	123	54	60
30									74	175	45	115
31										134	35	115
1917.												
1	270	32	307	43	45	142	330	180	186	60	11	312
2	120	36	193	42	44	141	356	143	92	51	10	237
3	46	47	142	43	45	127	326	171	89	45	9.5	180
4	71	37	111	45	43	214	236	167	80	38	8.6	140
5	42	41	128	46	43	90	273	128	66	35	8.2	121
6	36	49	107	90	42	91	307	165	72	29	7.2	90
7	48	49	91	127	41	47	313	165	90	25	6.9	77
8	47	45	90	123	37	43	314	143	126	20	6.2	60
9	39	42	77	137	36	73	273	130	161	21	6.2	50
10	35	41	74	132	34	75	220	125	137	18	80	54
11	39	36	75	171	34	75	195	112	188	16	127	45
12	36	32	77	171	35	75	179	114	220	30	74	39
13	26	37	73	95	34	65	155	200	292	51	55	36
14	37	47	71	93	32	55	133	90	229	40	40	30
15	30	57	63	137	29	90	145	55	133	34	31	27
16	30	53	56	165	29	75	136	71	170	33	30	24
17	30	43	56	157	26	65	132	65	157	24	100	22
18	25	42	53	134	26	113	137	60	186	35	223	20
19	27	36	52	113	25	127	135	55	170	41	223	19
20	56	37	49	86	24	96	125	46	134	43	151	18
21	54	32	47	71	24	90	170	47	110	36	115	17
22	75	29	54	65	24	93	176	45	90	28	94	17
23	65	31	54	60	23	157	165	67	80	26	74	15
24	56	112	173	56	25	202	155	107	73	20	67	14
25	49	155	104	53	29	344	143	104	88	28	63	14
26	44	179	90	51	33	351	127	88	78	34	51	14
27	42	89	77	51	93	445	127	66	65	25	43	13
28	35	75	70	46	123	775	128	67	56	19	36	13
29	32	71	65	46	....	673	121	90	51	16	30	14
30	31	90	57	45	....	510	117	145	60	14	377	14
31	30	....	49	45	....	429	....	130	....	12	413	....

NOTE.—1916: Record revised by means of data obtained in 1917; supersedes that published in Water-Supply Paper 431.
1917: Stage-discharge relation affected by ice Feb. 9-26; discharge determined from study of gage-height graph, observer's notes, and weather records.

Monthly discharge of East Branch of Tully River near Athol, Mass., for the years ending Sept. 30, 1916 and 1917.

[Drainage area, 50.2 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1916.					
June 13-30	243	74	144.	2.87	1.92
July	401	18	77.0	1.53	1.76
August	106	12	41.9	.835	.96
September	289	10	75.3	1.50	1.67
1916-17.					
October	137	27	50.0	0.996	1.15
November	155	29	53.9	1.07	1.19
December	200	47	83.4	1.66	1.91
January	165	42	81.1	1.62	1.87
February	123	23	38.6	.769	.80
March	775	65	191	3.80	4.38
April	355	117	196	3.90	4.35
May	165	45	103	2.05	2.36
June	282	51	121	2.41	2.69
July	60	12	31.2	.622	.72
August	413	6.2	84.8	1.69	1.95
September	312	12	59.2	1.18	1.32
The year	775	6.2	91.3	1.82	24.69

NOTE.—Record for 1916 revised by means of data obtained in 1917, and supersedes that published in Water-Supply Paper 431.

MOSS BROOK AT WENDELL DEPOT, MASS.

LOCATION.—About a quarter of a mile above confluence with Millers River and a quarter of a mile from Wendell Depot, Franklin County.

DRAINAGE AREA.—12.2 square miles (measured on topographic maps).

RECORDS AVAILABLE.—June 7, 1916, to September 30, 1917. From June 4 to October 16, 1909, records were obtained at a station near the mouth of the stream, and from April 25 to August 27, 1910, at a weir a short distance below the present site.

GAGE.—Sloping staff on left bank; read by C. M. Porter.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Bed composed principally of ledge rock and boulders. Control permanent.

EXTREMES OF DISCHARGE.—1916-17: Maximum stage recorded during the year, 3.52 feet at 12.45 p. m. March 28, 1917 (discharge, by extension of rating curve, about 187 second-feet); minimum stage recorded, 0.86 foot at 7.30 a. m., August 29, 1917 (discharge, by extension of rating curve, about 0.6 second-foot).

ICE.—Stage-discharge relation slightly affected by ice for short periods.

REGULATION.—Flow not affected by regulation.

ACCURACY.—Stage-discharge relation permanent, except when affected by ice. Rating curve well defined between 2 and 20 second-feet and fairly well defined between 20 and 60 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table with corrections for ice during the winter. Records good.

Discharge measurements of Moss Brook at Wendell Depot, Mass., during the year ending Sept. 30, 1917.

Date.		Made by—	Gage height.	Discharge.	Date.		Made by—	Gage height.	Discharge.
			Feet.	*Sec.-ft.*				*Feet.*	*Sec.-ft.*
Nov.	9	Hardin Thweatt	1.33	7.4	Feb.	3	H. H. Khachadoorian	1.43	10.8
Dec.	8	A. H. Davison	1.52	14.7	Apr.	5	Hardin Thweatt	2.16	52
	8	do	1.51	12.9		5	do	2.16	52
	20	Hardin Thweatt	[a] 1.43	8.9	June	2	do	1.75	27.2
Jan.	19	H. H. Khachdoorian	1.75	28.9		2	do	1.75	25.8
	19	Hardin Thweatt	1.75	29.5	Aug.	3	M. R. Stackpole	1.60	2.9

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Moss Brook at Wendell Depot, Mass., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	18	6.3	44	9	12	42	39	24	28	18	1.6	19
2	11	6.1	36	9	10	39	72	35	25	14	2.0	13
3	9.2	7.0	23	9	10	23	61	33	24	11	2.7	9.7
4	7.8	6.3	20	9	10	19	58	28	21	10	1.7	6.1
5	7.0	10	18	10	10	18	52	36	19	8.9	1.4	4.3
6	6.6	12	18	22	10	17	55	50	25	7.8	1.3	4.0
7	5.7	9.4	16	21	10	17	63	41	34	7.3	1.2	3.6
8	5.2	8.1	13	22	10	16	50	35	44	6.8	1.0	3.6
9	4.5	7.5	15	26	10	19	45	32	45	6.3	1.2	3.0
10	4.1	7.5	19	21	9	19	42	29	39	5.9	27	2.7
11	4.1	7.0	14	19	9	20	37	27	31	6.3	7.8	2.3
12	4.0	6.1	15	18	9	20	36	27	61	18	4.0	2.1
13	3.6	6.1	18	13	9	21	34	26	62	12	2.5	1.8
14	4.6	12	18	20	9	22	32	23	49	10	2.1	1.8
15	3.8	12	17	22	8	21	31	21	54	10	1.7	1.7
16	3.8	9.4	13	45	8	20	30	19	43	8.4	2.8	1.6
17	3.8	8.1	12	35	8	23	27	18	52	6.8	5.7	1.5
18	3.4	7.5	10	26	8	33	27	17	43	12	3.8	1.5
19	3.4	7.5	9	22	8	34	27	16	33	12	2.7	1.4
20	21	7.5	9	20	8	31	31	15	27	10	1.8	1.3
21	16	7.5	8	16	8	28	40	14	28	8.1	1.6	1.8
22	10	7.3	28	15	8	27	37	16	19	7.0	1.6	1.6
23	8.6	7.0	20	13	8	37	33	22	16	5.7	1.6	1.4
24	7.8	33	27	13	8	63	29	30	21	4.5	2.1	1.4
25	6.8	29	28	13	10	112	26	29	22	3.8	1.6	1.4
26	6.6	25	17	12	20	98	22	24	20	3.3	1.2	1.3
27	5.9	22	14	10	63	98	25	22	18	3.0	1.0	1.4
28	5.2	15	13	11	47	161	31	22	14	2.4	.8	2.5
29	5.2	12	11	11	......	108	27	49	13	2.4	10	1.8
30	5.0	35	11	13	......	74	24	48	23	2.4	45	1.7
31	5.2	......	9	12	......	70	......	36	......	1.8	31	......

NOTE.—Stage-discharge relation affected by ice Dec. 14 to Jan. 21, and Feb. 8–13; discharge determined from a study of gage-height graph, discharge measurements, and weather records.

Monthly discharge of Moss Brook at Wendell Depot, Mass., for the year ending Sept. 30, 1917.

[Drainage area, 12.2 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	21	3.4	7.00	0.574	0.66
November	35	6.1	11.9	.975	1.09
December	44	8	17.5	1.43	1.65
January	45	9	17.9	1.47	1.70
February	63	8	12.8	1.05	1.09
March	161	16	43.3	3.55	4.09
April	72	22	39.0	3.20	3.57
May	50	14	28.5	2.34	2.70
June	62	13	31.6	2.59	2.89
July	18	1.8	7.93	.650	.75
August	45	.8	5.60	.459	.53
September	19	1.3	3.41	.280	.31
The year	161	.8	18.9	1.55	21.03

DEERFIELD RIVER AT CHARLEMONT, MASS.

LOCATION.—1 mile below village of Charlemont, Franklin County.

DRAINAGE AREA.—362 square miles (measured on topographic maps).

RECORDS AVAILABLE.—June 19, 1913, to September 30, 1917.

GAGES.—Friez water-stage recorder on left bank, referred to gage datum by a hook gage inside the well; an outside sloping staff gage is used for auxiliary readings.

DISCHARGE MEASUREMENTS.—Made from cable or by wading.

CHANNEL AND CONTROL.—Bed covered with coarse gravel and boulders; section fairly uniform. Control practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 7.53 feet at 10.30 p. m. April 21 (discharge, 9,760 second-feet); minimum stage during year, from water-stage recorder, 1.41 feet at 10 a. m. August 7 (discharge, 34 second-feet).

1913–1917: Maximum stage recorded, 15.7 feet on July 8, 1915 (discharge by extension of rating curve, about 45,000 second-feet); minimum stage recorded, 1.35 feet on September 21 and November 3, 1914 (discharge, 23 second-feet).

ICE.—River is usually frozen over during the greater part of the winter; ice jams occasionally form below the gage causing several feet of backwater.

REGULATION.—Flow during low and medium stages largely regulated by a storage reservoir at Somerset, Vt. Several power plants above the station cause diurnal fluctuation.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve well defined. Operation of the water-stage recorder satisfactory except for short periods as shown in the footnote to the daily-discharge table. Daily discharge ascertained by use of discharge integrator. Records excellent.

Discharge measurements of Deerfield River at Charlemont, Mass., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan 2	A. H. Davison	a 6.19	819	Feb. 24	H. H. Khachadoorian	a 4.94	596
22	H. H. Khachadoorian	a 5.09	530	Apr. 7	Hardin Thweatt	3.85	1,880
29	Hardin Thweatt	a 5.30	825				

a Stage-discharge relation affected by ice.

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	Jan.	Feb.	Mar.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Note.—[illegible]

Monthly discharge of Deerfield River at Charlemont, Mass., for the year ending Sept. [illegible] 19[illegible].

[Drainage area [illegible] square miles.]

Month.	Discharge in second-feet. Maximum.	Minimum.	Mean.	Gain or loss in storage at Somerset. Millions of cubic feet.	Discharge corrected for storage, second-feet. Mean.	Per square mile.	[illegible]
October	[illegible]	[illegible]	[illegible]	−[illegible]	[illegible]	[illegible]	[illegible]
November	[illegible]	[illegible]	[illegible]	−[illegible]	[illegible]	2.[illegible]	[illegible]
December	[illegible]	[illegible]	[illegible]	−[illegible]	642	1.77	[illegible]
January	[illegible]	[illegible]	[illegible]	−[illegible]	[illegible]	1.33	[illegible]
February	[illegible]	[illegible]	[illegible]	−[illegible]	[illegible]	1.12	[illegible]
March	[illegible]	[illegible]	1,[illegible]	−[illegible]	1,3[illegible]	3.62	[illegible]
April	[illegible]	[illegible]	2,[illegible]	−[illegible]	2,[illegible]	7.[illegible]	[illegible]
May	2,[illegible]	[illegible]	1,[illegible]	−[illegible]	1,[illegible]	4.36	[illegible]
June	2,[illegible]	[illegible]	[illegible]	−[illegible]	994	2.73	[illegible]
July	[illegible]	[illegible]	[illegible]	−[illegible]	[illegible]	.746	[illegible]
August	1,[illegible]	[illegible]	[illegible]	−[illegible]	[illegible]	.765	[illegible]
September	[illegible]	[illegible]	309	−[illegible]	140	.387	[illegible]
The year	7,140	[illegible]	[illegible]	306	[illegible]	2.25	[illegible]

Note.—The increase (+) or decrease (−) of water held in storage at Somerset, Vt., during the month [illegible] been computed by engineers of the Geological Survey from data of storage increase or decrease furnished [illegible] the company operating the reservoir.

WARE RIVER AT GIBBS CROSSING, MASS.

[LOCATIO]N.—Between highway and electric-railway bridges at Gibbs Crossing, about [thr]ee-quarters of a mile above mouth of Beaver Brook and 3 miles below Ware, [Ha]mpshire County.

[DRAINA]GE AREA.—201 square miles (measured on topographic maps).

[RECOR]DS AVAILABLE.—August 20, 1912, to September 30, 1917.

[GAGE].—Barrett & Lawrence water-stage recorder on the right bank; referred to gage [da]tum by a hook gage inside of well; inclined staff gage used for auxiliary [re]adings.

[DISCH]ARGE MEASUREMENTS.—Made from the electric railway bridge or by wading.

[CHAN]NEL AND CONTROL.—Bed rough; subject to aquatic vegetation during summer [m]onths. Control free from weeds and at ordinary stages well defined at a [s]ection near the gage; at high stages the control is probably at the dam at Thorndike, 4 miles below the gage.

[EXT]REMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, [5].25 feet at 6 p. m. March 28 (discharge, 2,430 second-feet); a stage of 6.0 feet was recorded at 10 a. m. February 27, but the water was held back by an ice jam; minimum stage during year, from water-stage recorder, 1.45 feet at 4 p. m. September 30 (discharge, 21 second-feet).

1912–1917: Maximum open-water stage recorded, 5.9 feet on March 2, 1914 (discharge, 2,770 second-feet); minimum stage recorded, 1.20 feet on October 26, 1914 (discharge, 5 second-feet).

[IC]E.—River usually freezes over, and the stage-discharge relation is seriously affected by the ice; the large diurnal fluctuation in flow causes a variable backwater effect.

[RE]GULATION.—Flow affected by operation of mills at Ware, which at low stages causes a large variation in discharge on days when the mills are in operation, and a low discharge on Sundays and holidays.

[A]CCURACY.—Stage-discharge relation practically permanent except, when affected by ice. Rating curve well defined. Operation of water-stage recorder satisfactory, except for short periods as shown in footnote to daily-discharge table. Daily discharge ascertained by use of discharge integrator. Records good.

Discharge measurements of Ware River at Gibbs Crossing, Mass., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 24	H. H. Khachadoorian	[a]3.16	223	Mar. 4	Hardin Thweatt	2.97	451
Feb. 26	do	[a]3.94	382	Aug. 13	M. R. Stackpole	2.05	119

[a] Stage-discharge relation affected by ice.

SWIFT RIVER AT WEST WARE, MASS.

LOCATION.—About 1,000 feet below old wooden dam opposite West Ware station of Boston & Albany Railroad, 6 miles downstream from Enfield, Hampshire County, and 3 miles below confluence of East and West branches of Swift River.

DRAINAGE AREA.—186 square miles (measured on topographic maps).

RECORDS AVAILABLE.—July 15, 1910, to September 30, 1917.

GAGES.—Barrett & Lawrence water-stage recorder on left bank, referred to gage datum by means of a hook gage inside the well; an inclined staff gage is used for auxiliary readings. Prior to August 25, 1912, a chain gage on foot bridge 600 feet upstream from the present station.

DISCHARGE MEASUREMENTS.—Made from cable or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and alluvial deposits; some aquatic vegetation in channel during summer. Control practically permanent after change during high water of April 3, 1916, when part of dam was destroyed; at high stages, the control is probably at the dam at Bondsville, 4 miles below the gage.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 7.9 feet some time between March 23 and April 1 (discharge, 1,800 second-feet); minimum stage during year, from water-stage recorder, 1.87 feet at 8 a. m. August 9 (discharge, 67 second-feet).

1910–1917: Maximum stage recorded, 9.1 feet on February 26, 1915 (discharge, by extension of rating curve, 2,240 second-feet); minimum stage recorded, 1.36 feet on September 22, 1914 (discharge, 22 second-feet).

ICE.—River usually freezes over; stage-discharge relation somewhat affected by ice.

REGULATION.—Operation of mills at Enfield, 6 miles above the station, affects distribution of flow at low and medium stages, but has only a slight effect when the mean daily discharge exceeds 200 second-feet.

ACCURACY.—Stage-discharge relation practically permanent, except for a change during high water April 3, 1916, caused by the washing out of a portion of an old timber dam just above the station. Rating curve fairly well defined below 1,200 second-feet. Daily discharge ascertained by applying to rating table mean daily gage height determined by inspecting gage-height graph or, for days of considerable fluctuation, by averaging the mean gage heights of 4-hour periods with corrections for ice during the winter. Records December 12, 1916, to March 25, 1917, only fair; good for remainder of year.

Discharge measurements of Swift River at West Ware, Mass., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 24	H. H. Khachadoorian..	a 3.32	222	Mar. 5	Hardin Thweatt.......	a 4.05	352
Feb. 27	.....do................	a 4.59	603	Aug. 13	M. R. Stackpole........	2.27	123

a Stage-discharge relation affected by ice.

[illegible] discharges [illegible]

[illegible] Mar. [illegible]

[illegible]

[illegible] discharge determined from [illegible] similar [illegible] and Sept. [illegible] estimated [illegible] *nthly discharge of Swift River at West Ware, Mass., for the years ending Sept. 30, 1916–17.*

[Drainage area, 186 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1915–16.					
ber	188	89	127	0.683	0.79
ember	277	82	136	.731	.82
ember	1,100	82	340	1.83	2.11
uary	830	210	429	2.31	2.66
ruary	1,200	210	417	2.24	2.42
ch	1,290	275	535	2.88	3.32
il	1,770	575	985	5.30	5.91
y	882	232	442	2.38	2.74
e	708	225	408	2.19	2.44
y	830	131	297	1.60	1.84
ust	455	97	185	.995	1.15
tember	308	97	185	.995	1.11
The year	1,770	82	373	2.01	27.31
1916–17.					
tober	310	120	169	.909	1.05
vember	320	136	184	.989	1.10
cember	410	180	270	1.45	1.67
uary	460	110	234	1.26	1.45
bruary	830	100	172	.925	.92
rch	1,260	340	645	3.47	4.00
ril	1,120	375	585	3.15	3.51
y	560	250	398	2.14	2.47
ne	610	225	379	2.04	2.28
ly	255	104	169	.909	1.05
gust	300	82	118	.634	.73
ptember	275	85	121	.651	.73
The year	1,260	82	288	1.55	20.96

NOTE.—Record for 1916 revised by means of data obtained during 1917; supersedes that published in ater-Supply Paper 431.

[illegible]

[illegible] near West Brimfield [illegible] one-third of a mile above mouth of [illegible]

[illegible] water-stage recorder. [illegible]

[illegible] September 30, [illegible]

[illegible] water-stage recorder [illegible] downstream end of [illegible] gage [illegible] vertical [illegible] August [illegible] a vertical staff [illegible] present gage.

[illegible]—Made from highway bridge or by wading near bridge.

[illegible]—[illegible] gravel, and [illegible]

[illegible]—Maximum open-water stage during year ending September [illegible] from water-stage recorder [illegible] April [illegible] discharge [illegible] January [illegible] Minimum stage during year from water-stage recorder [illegible] September [illegible] discharge [illegible] second-feet.

[illegible] stage during year ending September 30, [illegible] from water-stage recorder [illegible] March [illegible] and [illegible] March [illegible] second-feet [illegible] recorded at [illegible] Minimum stage during year from water-stage recorder [illegible] September [illegible] discharge, about [illegible] second-feet.

[illegible] stage recorded, [illegible] feet on March [illegible] discharge [illegible] Minimum stage recorded, 1.40 feet on September [illegible] and [illegible] second-feet.

[illegible] stage-discharge relation affected by ice. The [illegible] effect from backwater.

[illegible] power plants at West Warren, [illegible] discharge on days when the mills are in operation and a low discharge on Sundays and holidays.

[illegible] permanent since change in March [illegible] Rating curve well defined. [illegible] water-stage recorder was satisfactory except for short periods as shown in the [illegible] daily-discharge tables. Daily discharge ascertained as follows: [illegible] March 25, [illegible] mean daily gage [illegible] March 25, [illegible] to September 30, [illegible] during the winter. Records good except for periods affected by ice, for which they are fair.

Discharge measurements of [illegible] at West Brimfield, Mass., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	Sec.-ft.			Feet.	Sec.-ft.
Dec. 22	Hardin Thomas	[illegible]	[illegible]	[illegible]	Hardin Thomas	[illegible]	[illegible]
Jan. 25	do	[illegible]	[illegible]	[illegible]	[illegible]	2.54	[illegible]
Mar. 3	do	[illegible]	[illegible]				

a Stage-discharge relation affected by ice.

[1] Revised information, supersedes that published in Water-Supply Paper [illegible].

ily discharge, in second-feet, of Quaboag River at West Brimfield, Mass., for the years ending Sept. 30, 1916 and 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915–16.												
	59	101	103	340	380	774	1,080	510	240	225	455	130
	61	96	98	293	360	756	1,100	470	225	215	430	110
	56	87	98	270	350	749	1,140	455	200	240	395	114
	63	87	96	200	270	709	1,120	475	210	225	370	114
	78	98	65	350	350	682	1,080	445	210	220	340	138
	94	81	105	417	325	661	1,020	420	235	210	325	120
	100	69	87	391	325	640	930	410	225	200	310	114
	110	87	83	365	230	575	870	405	230	180	325	122
	110	94	67	340	293	483	840	365	245	176	350	93
	94	83	73	315	250	444	790	350	270	188	320	104
	118	69	73	340	250	423	780	325	310	184	310	132
	110	71	60	293	145	407	770	275	355	174	295	104
	100	69	73	302	145	380	740	285	360	172	280	97
	101	46	90	293	210	340	780	280	360	172	260	93
	105	105	110	176	175	315	800	280	350	150	240	110
	110	94	125	270	175	293	770	270	335	152	230	184
	90	89	176	250	145	298	740	460	390	160	220	172
	100	87	210	230	175	270	670	475	420	150	210	178
	110	110	401	200	175	250	610	440	445	142	194	178
	110	154	284	230	175	250	610	420	475	132	186	168
	120	133	250	250	175	250	580	415	455	168	190	164
	130	145	210	297	175	270	580	400	440	144	170	160
	130	125	210	380	175	250	620	385	415	210	152	144
	110	118	222	401	175	250	610	375	385	215	176	146
	136	110	238	370	210	280	580	345	380	210	160	150
	125	130	391	391	797	320	560	325	395	245	146	128
	123	98	306	417	688	450	530	300	355	465	144	120
	113	98	455	407	783	570	550	290	325	620	162	120
	110	125	455	380	774	660	540	280	290	530	152	120
	91	110	325	385	......	850	530	250	260	510	156	160
	77	......	293	385	......	1,040	......	255	......	490	140	......
1916–17.												
1	134	91	168	140	135	680	960	265	300	180	85	130
2	142	95	150	140	125	540	930	290	285	162	91	128
3	120	85	152	145	120	420	850	275	275	142	96	124
4	120	77	158	150	120	380	780	275	250	128	74	138
5	116	90	148	230	145	370	730	325	240	126	77	120
6	112	130	142	320	160	320	720	355	235	93	91	120
7	90	106	118	320	160	320	710	355	245	73	84	112
8	92	104	130	250	155	520	690	350	240	72	80	93
9	120	100	132	140	150	640	670	350	220	92	79	96
10	91	94	134	160	130	580	580	320	210	80	84	114
11	92	79	136	155	125	520	560	290	250	83	75	84
12	94	89	148	150	115	620	570	300	340	102	91	83
13	96	114	132	280	110	720	540	310	310	102	93	80
14	71	100	124	360	120	460	490	290	295	92	86	86
15	75	96	120	340	130	435	460	265	280	114	90	64
16	112	95	120	320	130	435	415	260	285	134	81	55
17	87	96	115	280	130	460	395	245	310	118	122	91
18	85	85	110	220	120	500	380	235	320	118	120	70
19	94	80	105	210	145	390	360	220	320	114	93	69
20	140	114	100	195	145	440	350	200	305	112	102	70
21	136	90	95	175	140	450	345	182	280	106	87	63
22	126	90	100	160	130	465	345	186	255	114	85	55
23	124	100	105	155	125	485	310	225	230	120	91	54
24	116	160	150	150	120	650	295	225	220	102	86	80
25	114	122	120	145	120	720	270	220	210	92	66	70
26	110	114	220	150	250	740	260	215	200	100	67	62
27	106	142	260	150	840	790	270	220	235	93	96	62
28	80	134	180	145	760	970	260	240	180	82	77	62
29	77	108	170	150	......	1,000	265	340	134	74	85	43
30	110	140	170	140	......	990	265	320	180	104	126	30
31	90	......	155	130	......	980	......	310	......	88	174	......

NOTE.—1915–16: Stage-discharge relation affected by ice, Dec. 14-18, 21-23, Dec. 31 to Jan. 4, Jan. 7-12, 16-21; Feb. 9-25, and Mar. 15-24; discharge determined for these periods from study of gage-height graph, discharge measurements, weather records, and comparison with similar studies for near-by streams. Discharge estimated Oct. 5, 7-9, 12, 13, 16-24, and Dec. 10-13. Records revised after Mar. 25, and supersede those published in Water-Supply Paper 431.

1916–17: Stage-discharge relation affected by ice Dec. 14–Mar. 13; discharge determined from study of gage-height graph, discharge measurements, weather records, and comparison with similar studies for near-by streams.

Monthly discharge of [illegible] River at West [illegible], Mass., for the years ending Sept. 30, [illegible] and [illegible].

[Drainage area, [illegible] square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
[illegible]					
October	[illegible]	[illegible]	[illegible]	[illegible]	0.[illegible]
November	[illegible]	[illegible]	[illegible]	[illegible]	.74
December	[illegible]	[illegible]	[illegible]	1.35	1.44
January	[illegible]	[illegible]	[illegible]	2.23	[illegible]
February	[illegible]	[illegible]	[illegible]	2.23	[illegible]
March	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
April	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
June	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
July	[illegible]	[illegible]	[illegible]	1.41	[illegible]
August	[illegible]	[illegible]	[illegible]	[illegible]	1.92
September	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
The year	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]					
October	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
November	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
December	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
January	[illegible]	[illegible]	[illegible]	1.33	1.53
February	[illegible]	[illegible]	[illegible]	1.35	[illegible]
March	[illegible]	[illegible]	[illegible]	[illegible]	4.46
April	[illegible]	[illegible]	[illegible]	3.34	3.73
May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
June	[illegible]	[illegible]	[illegible]	1.70	1.90
July	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
August	[illegible]	[illegible]	[illegible]	[illegible]	.70
September	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
The year	[illegible]	30	[illegible]	1.46	19.91

NOTE.—Determinations for [illegible] revised by means of data obtained in [illegible]; supersede those published in Water-Supply Paper [illegible].

WESTFIELD RIVER AT KNIGHTVILLE, MASS.

LOCATION.—At single-span steel highway bridge known locally as Pitcher Bridge, in Knightville, Hampshire County, 1 mile north of outlet of Norwich Lake, and about 3 miles above confluence with Middle Branch of Westfield River.

DRAINAGE AREA.—162 square miles (measured on topographic maps).

RECORDS AVAILABLE.—August 2[illegible], 1909, to September 30, 1917.

GAGE.—Chain attached to downstream side of highway bridge; read by J. A. Burr.

DISCHARGE MEASUREMENTS.—Made from highway bridge or by wading.

CHANNEL AND CONTROL.—Channel rough, composed of boulders and ledge rock; control practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.8 feet at 7 a. m. March 28 (discharge, 3,030 second-feet); minimum stage recorded, 0.81 foot several times in September (discharge, 16 second-feet).

1909–1917: Maximum open-water stage recorded, 8.9 feet on March 27, 1913 (discharge by extension of rating curve, about 5,100 second-feet); a gage height of 9.4 feet was recorded at 9.15 a. m. January 22, 1910, but channel was probably obstructed by ice at that time; minimum stage recorded, 0.60 foot on August 10, 1913 (discharge, 4 second-feet).

ICE.—Ice usually forms in the river early in the winter and seriously affects the stage-discharge relation.

REGULATION.—Flow not seriously affected by regulation.

ACCURACY.—The stage-discharge relation has probably remained permanent, except during ice periods, although individual discharge measurements have at times appeared erratic; the rough and irregular channel causes difficulty in obtaining accurate discharge measurements. Rating curve fairly well defined below 2,000 second-feet. Gage read to hundredths twice daily, except during the winter, when it was read once daily. Daily discharge ascertained by applying mean daily gage heights to rating table with corrections for ice during the winter. Records good.

Discharge measurements of Westfield River at Knightville, Mass., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 5	A. H. Davison	2.17	238	May 24	Hardin Thweatt	2.64	470
5	.....do	2.18	278	June 1	.....do	2.57	398
Jan. 5	.....do	a 2.44	126	1	.....do	2.57	400
Feb. 5	.....do	a 2.40	99	Aug. 7	M. R. Stackpole	1.14	35.2
Mar. 2	.....do	a 4.12	386	7	.....do	1.12	34.0
28	Hardin Thweatt	5.27	2,590	17	.....do	1.02	28.1

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Westfield River at Knightville, Mass., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	222	94	730	120	140	640	1,520	412	412	200	50	55
2	125	129	395	195	110	420	1,690	595	390	172	47	52
3	97	104	272	165	90	310	1,280	512	345	167	55	47
4	88	97	238	140	88	240	1,120	435	305	138	57	45
5	82	139	255	110	82	180	1,120	460	265	117	50	37
6	73	182	255	680	100	165	980	980	655	103	44	30
7	64	174	207	520	90	180	1,120	780	910	92	43	27
8	66	153	185	270	82	240	1,120	715	1,120	81	37	30
9	60	143	196	250	74	400	845	655	568	81	41	37
10	55	166	291	240	74	270	655	540	460	89	47	33
11	54	151	158	220	68	210	595	460	1,050	107	43	30
12	54	134	207	120	68	270	568	435	1,690	625	30	27
13	54	104	185	155	60	500	540	435	1,360	215	27	23
14	54	123	156	290	60	350	485	345	780	147	31	22
15	82	174	139	920	60	310	512	285	980	157	29	22
16	66	125	135	780	60	270	460	285	540	162	29	22
17	60	101	135	640	60	350	435	248	485	138	30	22
18	56	114	130	580	60	400	595	230	412	152	28	22
19	56	114	130	370	60	240	625	200	345	305	29	21
20	238	116	120	220	74	210	1,120	200	305	248	27	21
21	171	116	120	165	74	210	1,050	183	215	145	23	19
22	129	114	155	155	60	350	980	200	200	115	22	18
23	92	121	450	130	48	560	780	655	180	103	20	19
24	82	1,050	330	120	68	980	625	485	230	87	41	18
25	77	291	270	110	60	2,140	485	390	265	73	65	18
26	80	185	195	100	82	1,690	435	285	197	70	39	17
27	77	148	120	90	920	1,780	435	230	265	76	30	17
28	73	158	165	82	980	2,730	485	248	230	68	24	18
29	70	169	155	82	....	1,440	390	2,140	167	58	26	19
30	64	920	130	82	....	1,050	485	1,050	655	58	68	21
31	61	....	130	100	....	910	....	540	....	56	68	....

NOTE.—Stage-discharge relation affected by ice Dec. 16-Mar. 24; discharge determined from study of gage-height graph, discharge measurements, weather records, and comparison with similar study for Westfield River near Westfield.

Discharge measurements of Westfield River near Westfield, Mass., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 6	A. H. Davison	4.44	683	Aug. 14	M. R. Stackpole	3.52	172
Feb. 2	.....do	a 4.27	435	14	.....do	3.47	170

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Westfield River near Westfield, Mass., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	640	250	1,780	460	480	2,200	3,700	1,060	1,350	670	210	330
2	485	270	1,060	560	460	1,320	5,200	1,560	1,200	600	184	335
3	310	325	790	490	450	1,020	3,200	1,360	1,100	530	205	215
4	295	260	710	500	290	830	2,850	1,100	1,020	385	215	240
5	290	265	660	560	400	790	2,850	1,400	830	445	235	295
6	270	560	650	940	390	670	2,800	2,250	1,200	360	178	210
7	250	505	600	1,220	380	600	2,750	2,200	2,100	365	205	190
8	300	380	550	1,010	340	660	2,700	1,900	2,500	330	180	200
9	192	420	505	830	320	820	2,300	1,720	1,500	315	154	275
10	184	405	630	760	290	880	1,800	1,420	1,180	325	305	185
11	184	470	590	660	290	780	1,540	1,220	1,980	370	280	162
12	200	335	590	680	280	840	1,600	1,100	3,750	620	220	156
13	225	320	610	620	270	1,200	1,480	1,080	2,450	640	180	162
14	260	325	480	930	270	1,140	1,440	1,020	1,720	540	180	172
15	162	400	435	1,840	260	950	1,360	900	2,500	380	140	176
16	310	360	370	1,340	260	930	1,320	810	1,660	485	220	200
17	250	325	460	1,080	250	1,050	1,200	800	1,450	480	172	178
18	196	285	400	860	250	1,220	1,420	750	1,250	480	158	154
19	240	310	420	770	240	1,040	1,520	720	1,000	520	210	140
20	455	370	430	680	220	840	2,050	630	850	630	180	146
21	620	330	430	570	220	900	2,350	640	750	700	186	130
22	365	250	490	610	210	1,060	2,250	610	640	530	180	136
23	360	295	1,280	640	200	1,320	1,820	1,200	590	480	180	160
24	225	1,940	1,140	510	220	2,900	1,500	1,360	580	450	230	128
25	260	1,140	980	490	260	3,650	1,260	1,000	770	420	215	134
26	275	620	1,000	500	390	3,800	1,120	830	620	380	230	136
27	220	520	650	560	1,400	5,200	1,180	720	730	295	235	140
28	285	490	630	370	3,930	8,700	1,220	750	720	300	220	152
29	250	500	610	480	....	4,100	1,000	4,800	590	380	192	120
30	245	1,560	570	460	....	3,000	980	2,400	950	200	335	175
31	235	....	460	460	....	2,400	....	1,600	....	215	335	....

NOTE.—Stage-discharge relation affected by ice Feb. 1-26; discharge determined from study of gage-height graph, one discharge measurement, weather records, and comparison with similar study for Westfield River at Knightville. No gage-height record Apr. 6-7, May 28-31, June 1-2, and 17-23; discharge estimated.

ACCURACY.—Stage-discharge relation changed during high water in March, 1917; seriously affected by ice from December to March. Rating curve used to March 24, 1917, well defined below 400 second-feet by discharge measurements and is very nearly parallel to preceding curve; above 400 second-feet the new curve was extended as a parallel curve; rating curve used March 24 to September 30, fairly well defined by discharge measurements up to 1,000 second-feet. Operation of water-stage recorders not entirely satisfactory. Daily discharge ascertained by applying to rating table mean daily gage height determined by inspecting recorder graph, except for periods as noted in footnote to daily discharge table. Records fair.

Discharge measurements of Middle Branch of Westfield River at Goss Heights, Mass., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 4	A. H. Davison	1.24	62	Mar. 30	Hardin Thweatt	2.12	313
4	.....do	1.23	62	May 23	.....do	1.78	177
Jan. 5	.....do	a1.84	46.0	23	.....do	1.79	181
26	Hardin Thweatt	a2.66	40.9	Aug. 8	M. R. Stackpole	.81	6.8
Feb. 3	A. H. Davison	a2.54	27.8	8	.....do	.81	6.8
Mar. 1	.....do	a3.48	177	17	.....do	.83	7.2
28	Hardin Thweatt	3.22	927				

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Middle Branch of Westfield River at Goss Heights, Mass., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	60	28	143	25	40	175	759	112	104	37	8.0	10
2	35	43	110	86	33	145	642	186	98	35	8.0	8.5
3	30	35	84	78	28	105	428	123	86	28	9.0	8.0
4	28	28	70	62	27	72	365	90	70	24	10	7.5
5	25	43	82	46	26	74	328	182	61	21	8.0	7.5
6	20	62	82	250	25	78	314	260	162	18	7.0	7.5
7	18	56	70	160	22	82	340	235	328	17	7.0	7.0
8	17	48	58	82	20	120	350	219	296	17	6.5	9.0
9	16	43	62	62	17	160	270	182	142	15	7.0	8.5
10	15	48	105	52	16	130	175	129	139	14	8.5	8.0
11	15	43	52	28	14	105	139	109	346	19	8.5	8.0
12	14	34	72	26	13	145	142	101	532	44	8.0	8.0
13	13	27	62	35	12	190	129	95	235	35	7.5	7.0
14	12	31	58	62	11	160	129	79	252	25	7.5	7.0
15	26	43	54	380	10	145	120	66	305	24	7.0	7.5
16	15	32	50	300	10	130	109	56	172	32	7.0	6.0
17	14	38	46	190	9.5	160	109	51	139	33	7.5	7.0
18	14	28	43	130	9.0	190	162	47	104	37	8.0	6.0
19	16	35	40	94	8.5	130	215	44	77	44	8.0	5.4
20	64	32	37	72	8.0	82	365	41	61	54	8.0	5.7
21	40	31	35	62	8.0	43	332	37	48	28	7.5	5.4
22	27	28	82	58	7.5	82	296	44	40	21	7.5	5.7
23	24	43	220	52	7.5	160	197	132	34	17	7.0	5.7
24	22	380	145	62	10	260	142	104	43	14	7.0	5.7
25	20	160	105	43	17	400	104	70	41	14	8.5	5.4
26	25	92	62	41	62	435	86	60	30	12	9.0	5.4
27	22	90	43	28	385	465	101	60	54	12	7.5	5.4
28	20	92	62	26	435	880	104	83	37	11	6.5	5.4
29	18	66	46	24	....	400	86	658	33	10	6.5	6.5
30	17	380	37	35	....	320	93	256	70	10	9.5	6.0
31	16	....	28	52	....	310	....	142	....	9.0	13	....

NOTE.—Stage-discharge relation affected by ice Dec. 15–Mar. 24; discharge determined from study of gage-height graph, discharge measurements, weather records, and comparison with similar study for Westfield River at Knightville. Discharge estimated by comparison with Westfield River at Knightville, because of no gage-height record Oct. 1-15, 24-31, Nov. 1-9, 20-25, 30, Dec. 5-14; Mar. 26-29, Apr. 7-10, July 1-2, 17, and Aug. 4-7.

Monthly discharge of Middle Branch of Westfield River at Goss Heights, Mass., for the year ending Sept. 30, 1917.

[Drainage area, 53 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	64	12	23.1	0.436	0.50
November	380	27	71.3	1.35	1.51
December	220	28	72.4	1.37	1.58
January	380	24	87.2	1.65	1.90
February	435	7.5	45.7	.862	.90
March	880	43	204	3.85	4.44
April	759	86	238	4.49	5.01
May	658	37	131	2.47	2.85
June	532	30	138	2.60	2.90
July	54	9.0	23.6	.445	.51
August	13	6.5	7.92	.149	.17
September	10	5.4	6.86	.129	.14
The year	880	5.4	87.5	1.65	22.41

WESTFIELD LITTLE RIVER NEAR WESTFIELD, MASS.

LOCATION.—At diversion dam of Springfield waterworks, in town of Russell, Hampden County, 3 miles below confluence of Pebble and Borden brooks and about 3 miles west of Westfield. Originally (July, 1905, to December, 1909) a short distance below Borden Brook, near Cobble Mountain.

DRAINAGE AREA.—43 square miles at original site; 48 square miles at present site.

RECORDS AVAILABLE.—July 13, 1905, to September 30, 1917.

DETERMINATION OF DISCHARGE.—At the original site below Borden Brook (used 1905–1909) the discharge was determined by methods commonly employed at current-meter gaging stations. From August, 1906, to September, 1907, a 30-foot weir was maintained a short distance below the gage.[1]

Since March 1, 1910, high-water flow determined from continuous records of head on concrete diversion dam (crest length, 155.4 feet), for which coefficients have been deduced from experiments at Cornell University; low-water flow, less than 163 second-feet, determined from continuous record of head on a 12-foot sharp-crested weir without end contractions, the crest being 2.55 feet below that of the dam. Water diverted to city of Springfield is measured by a 54-inch Venturi meter, using continuous record chart. Daily record corrected for storages in a reservoir on Borden Brook about 5 miles above station, but owing to the time required for water to reach the dam and the natural storage along the stream the record as corrected does not represent exactly the natural flow of the stream at all times.

EXTREMES OF DISCHARGE.—Maximum discharge for 24 hours recorded during year, 880 second-feet, March 27; minimum discharge for 24 hours recorded, 1.2 second-feet, October 16.

1909–1917: Maximum discharge for 24 hours, 1,490 second-feet, March 28, 1914; minimum discharge apparently zero at various times when the water released from the reservoir was equal to or greater than the total flow at the diversion dam.

DIVERSIONS.—Record of water diverted at station for municipal supply of Springfield included in records as published.

COOPERATION.—Data collected and compiled under the direction of E. E. Lochridge, chief engineer, board of water commissioners, Springfield, Mass.

[1] Results obtained by weir and current-meter methods are compared in U. S. Geol. Survey Water-Supply Papers 201, pp. 105–110, and 241, pp. 164–168.

Daily discharge, in second-feet, of Westfield Little River near Westfield, Mass., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	80.4	28.1	160	40.2	37.7	123	584	115	111	37.7	15.6	19.8
2	58.1	29.4	109	43.9	32.3	55.5	651	163	112	31.8	6.9	17.7
3	34.8	20.4	91.0	39.7	32.9	73.5	462	128	116	26.5	14.2	15.8
4	27.3	20.1	64.4	39.8	42.3	57.4	412	107	96.3	21.4	12.6	15.1
5	31.9	79.4	66.0	50.0	42.5	49.4	396	199	76.9	18.0	10.4	13.3
6	19.3	72.0	57.8	134	43.2	40.5	371	335	92.0	15.4	9.7	12.6
7	27.6	40.9	51.3	119	41.8	27.7	465	334	146	15.1	13.3	12.0
8	25.9	48.3	43.5	102	35.1	20.0	374	267	128	6.3	13.4	13.1
9	10.0	31.0	45.9	86.5	34.0	13.4	290	213	99.6	9.1	12.1	12.2
10	6.6	28.2	54.4	81.1	36.7	7.9	231	145	96.0	15.8	22.6	13.2
11	6.3	35.1	46.3	61.0	33.4	11.6	183	126	210	40.8	15.0	11.8
12	10.0	22.6	54.6	42.6	33.6	15.2	190	106	321	48.1	10.8	11.4
13	10.4	32.6	51.3	63.1	34.6	23.5	174	108	219	28.0	12.0	10.8
14	24.8	22.6	37.0	479	35.2	23.5	152	88.0	167	31.0	10.4	8.8
15	19.6	33.0	31.4	289	35.1	27.7	149	82.9	172	20.1	10.3	8.3
16	1.2	18.3	35.7	159	35.8	31.5	145	74.7	119	19.0	10.3	10.2
17	5.0	20.8	39.4	118	35.9	45.8	135	51.6	107	21.7	10.6	10.5
18	8.3	19.0	47.8	97.0	28.6	57.4	158	47.0	82.9	28.9	9.5	10.5
19	20.4	19.0	43.9	87.2	26.1	45.3	188	45.6	73.3	34.3	9.2	10.0
20	40.7	18.1	33.8	62.4	25.9	38.0	216	42.9	58.1	18.9	8.4	10.1
21	101	25.3	33.7	51.8	25.9	40.2	242	41.6	39.4	17.2	9.2	11.7
22	48.4	18.1	146	50.3	23.7	93.8	374	62.7	39.6	13.5	8.8	10.5
23	46.2	97.4	154	38.0	25.6	142	310	204	35.3	14.7	12.6	6.4
24	28.7	241	121	35.5	40.8	291	199	136	31.1	17.4	17.6	7.0
25	24.5	109	104	35.0	32.4	281	142	112	28.4	20.8	10.1	6.8
26	19.8	88.3	80.2	31.4	36.6	375	124	86.6	27.7	16.5	8.3	6.6
27	19.1	57.1	76.2	34.2	229	880	125	107	48.1	16.0	12.2	6.5
28	19.6	47.0	65.7	33.9	272	639	117	134	35.7	11.6	11.7	7.2
29	18.6	64.0	47.7	32.8	......	421	104	464	38.2	17.2	21.5	7.3
30	10.5	171	42.7	32.9	......	291	99.7	268	56.7	12.9	28.2	8.6
31	19.4	......	38.2	30.4	......	174	......	158	......	11.1	24.0	......

Monthly discharge of Westfield Little River near Westfield, Mass., for the year ending Sept. 30, 1917.

[Drainage area, 48 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	101	1.2	26.6	0.554	0.64
November	241	18.1	51.9	1.08	1.20
December	160	31.4	66.9	1.39	1.60
January	479	30.4	83.9	1.75	2.02
February	272	23.7	49.6	1.03	1.07
March	880	7.9	142	2.96	3.41
April	651	99.7	259	5.39	6.01
May	464	41.6	147	3.06	3.53
June	321	27.7	99.4	2.07	2.31
July	48.1	6.3	21.2	.442	.51
August	28.2	6.9	12.9	.269	.31
September	19.8	6.4	10.9	.227	.25
The year	880	1.2	80.9	1.69	22.86

BORDEN BROOK NEAR WESTFIELD, MASS.

Location.—At outlet of Borden Brook reservoir in town of Granville, [illegible] miles above [illegible] and about [illegible] miles west of Westfield.

Drainage area.—[illegible] square miles.

Records available.—[illegible] to September 30, 1917.

Determination of discharge.—Flow determined from a continuous record of the head on a [illegible] sharp-crested weir without end contractions. The results are then corrected for the apparent gain or loss in storage water in the reservoir but [illegible] is made for evaporation.

Extremes of discharge.—Maximum 24-hour flow recorded during year, [illegible] second-feet [illegible]; minimum apparent flow [illegible] second-feet at various times when the apparent storage increase was equal to or greater than the measured flow at the weir.

[illegible]: Maximum 24-hour flow recorded, [illegible] second-feet [illegible]; minimum apparent flow, [illegible] second-feet.

Cooperation.—Records furnished by the board of water commissioners of Springfield through [illegible], chief engineer.

Daily discharge, in second-feet, of Borden Brook near Westfield, Mass., for the year ending [illegible]

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Note.—The figures [illegible] by subtracting from the quantity of water running over the weir the [illegible] amount apparently stored in the reservoir [illegible] allowance has been made for evaporation [illegible] flow at the outlet of the reservoir [illegible] the amount apparently resulting from storage was equal to or greater than the amount passing over the weir.

Monthly discharge of Borden Brook near Westfield, Mass., for the year ending Sept. 30, 1917.

[Drainage area, 8 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	10.8	....	2.38	0.298	0.34
November	51.0	....	8.36	1.04	1.16
December	24.2	....	5.58	.698	.80
January	30.6	....	7.21	.901	1.04
February	28.9	....	2.47	.309	.32
March	187	....	29.9	3.74	4.31
April	103	17.2	39.8	4.98	5.56
May	63.3	....	23.8	2.98	3.44
June	52.0	....	17.3	2.16	2.41
July	12.9	....	1.31	.164	.19
August	....	....	....	....	....
September	....	....	....	....	....
The year	187	....	12.4	1.55	19.57

NOTE.—For months for which no minimum is given, see footnote to daily discharge table.

FARMINGTON RIVER NEAR NEW BOSTON, MASS.

LOCATION.—At highway bridge a quarter of a mile below Clam River and about 1 mile south of New Boston, Berskhire County.

DRAINAGE AREA.—92.7 square miles (measured on topographic maps).

RECORDS AVAILABLE.—May 27, 1913, to September 30, 1917.

GAGES.—Barrett & Lawrence water-stage recorder on left bank, downstream side of bridge, referred to gage datum by a hook gage inside the well. Vertical staff on bridge abutment is used for auxiliary readings.

DISCHARGE MEASUREMENTS.—Made from from a cable or by wading.

CHANNEL AND CONTROL.—Bed rocky, covered with boulders. Control practically permanent except as affected by removal of rocks in measuring section.

EXTREMES OF DISCHARGE.—Maximum open-water stage during year, from water-stage recorder, 6.5 feet at 11 p. m. March 27 (discharge, 1,900 second-feet); a stage of 7.9 feet was recorded at 4 p. m. January 14, but the water was held back by an ice jam; minimum stage during year, from water-stage recorder, 2.54 feet at 4 a. m. September 6 (discharge, 18 second-feet).

1913–1917: Maximum open-water stage from water-stage recorder, 7.64 feet on October 26, 1913 (discharge, by extension of rating curve, about 3,200 second-feet); minimum stage from water-stage recorder, 2.22 feet on August 27, 1913 (discharge, 4.4 second-feet).

ICE.—River usually frozen over during greater part of winter; stage-discharge relation seriously affected. Ice jams occasionally form below the gage, causing several feet of backwater.

REGULATION.—Flow affected by storage in Otis reservoir, about 5 miles above New Boston, and by operation of a woodworking shop using water power just above the station.

ACCURACY.—Stage-discharge relation practically permanent except when affected by ice. Rating curve well defined below 1,700 second-feet. Operation of water-stage recorder satisfactory except for short periods as shown in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage height determined by inspecting gage height graph, or, for days of considerable fluctuation, by averaging the means of 4-hour periods. Winter records only fair; those for open-water periods good.

The following discharge measurement was made by H. H. Khachadoorian:

January 26, 1917: Gage height, 6.14 feet; discharge, 170 second-feet; stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Farmington River near New Boston, Mass., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	75	93	302	98	105	300	840	197	141	81	48	20
2	62	102	197	90	105	160	980	224	131	65	49	21
3	55	98	141	78	120	130	710	197	141	63	50	22
4	53	94	120	78	140	110	575	162	122	60	93	22
5	52	141	108	120	160	98	525	224	102	54	107	20
6	52	162	104	185	160	120	455	356	131	49	131	19
7	65	131	93	240	150	110	500	375	238	41	131	27
8	141	122	80	185	140	130	415	320	238	36	131	65
9	141	122	82	140	120	220	375	286	185	36	151	107
10	141	112	88	140	105	120	286	238	131	36	173	99
11	141	60	84	130	90	98	238	210	162	42	98	102
12	141	48	93	120	78	130	254	197	455	70	131	102
13	141	60	87	120	64	140	238	185	415	54	131	100
14	141	131	86	300	60	130	238	162	269	46	122	102
15	141	141	86	500	64	130	224	151	302	50	120	116
16	151	131	76	460	78	140	210	151	286	73	118	116
17	151	122	76	240	64	150	185	141	224	55	114	114
18	141	122	74	120	60	140	238	141	185	94	104	112
19	141	122	68	54	110	130	254	108	162	85	77	112
20	197	122	70	64	98	120	337	99	131	94	122	110
21	173	122	84	160	78	140	395	91	110	75	122	114
22	63	120	105	185	64	130	435	94	94	63	122	112
23	41	300	195	140	98	170	395	173	82	68	122	112
24	100	269	175	140	120	435	320	173	71	94	131	118
25	104	173	130	160	50	575	238	141	63	77	75	122
26	105	112	105	160	120	625	197	116	60	58	64	122
27	105	99	105	160	340	945	197	116	63	49	102	120
28	102	82	105	140	400	1,310	197	141	91	44	107	118
29	98	131	105	120	....	875	162	84	68	39	108	114
30	94	254	98	105	....	600	162	269	81	36	122	87
31	98	....	90	78	....	480	....	210	....	44	31	....

NOTE.—Stage-discharge relation affected by ice Dec. 15–Mar. 22; discharge determined from study of gage-height graph, one discharge measurement, weather records, and comparison with similar studies for nearby streams. Discharge Nov. 22 and 23 estimated by comparison with Housatonic River near Great Barrington.

Monthly discharge of Farmington River near New Boston, Mass., for the year ending Sept. 30, 1917.

[Discharge area, 92.7 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	197	41	110	1.19	1.37
November	300	48	130	1.40	1.56
December	302	68	110	1.19	1.37
January	500	54	162	1.75	2.02
February	400	50	119	1.28	1.33
March	1,310	98	293	3.16	3.64
April	980	162	359	3.87	4.32
May	375	84	185	2.00	2.31
June	455	60	164	1.77	1.98
July	94	36	59.1	.638	.74
August	173	31	107	1.15	1.33
September	122	19	88.2	.951	1.06
The year	1,310	19	157	1.69	23.03

HOUSATONIC RIVER BASIN.

HOUSATONIC RIVER NEAR GREAT BARRINGTON, MASS.

LOCATION.—At highway bridge about a quarter of a mile northeast of Van Deusenville station of New York, New Haven & Hartford Railroad (Berkshire division) and 2 miles north of Great Barrington, Berkshire County.

DRAINAGE AREA.—280 square miles (measured on topographic maps).

RECORDS AVAILABLE.—May 17, 1913, to September 30, 1917.

GAGE.—Inclined staff attached to concrete anchorages on downstream side of left abutment of highway bridge; vertical high-water section attached to bridge abutment; read by Martin Love.

DISCHARGE MEASUREMENTS.—Made from upstream side of highway bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; control practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.9 feet from 8.30 a. m. March 28 to 8.30 a. m. March 29 (discharge, 4,200 second-feet); minimum stage recorded, 0.7 foot at 8 a. m. September 27 (discharge, 13 second-feet).

1913–1917: Maximum stage recorded, 8.0 feet on March 31, 1916 (discharge from extension of rating curve, about 5,300 second-feet). Zero flow recorded at various times caused by storage of water at dams above.

ICE.—Stage-discharge relation occasionally affected by ice for short periods during the winter.

REGULATION.—Storage above dam of a paper mill about a mile above station causes low flow on Sundays and holidays.

ACCURACY.—Stage-discharge relation practically permanent since change during the high water of December 1, 1916; affected by ice for a few days in February. Rating curve used to November 30, fairly well defined by discharge measurements below 1,400 second-feet and by shape of old curve; rating curve used from December 1 to September 30 well defined below 2,000 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records fair.

Discharge measurements of Housatonic River near Great Barrington, Mass., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 12	Hardin Thweatt	1.28	96	Aug. 9	M. R. Stackpole	1.84	274
Jan. 7	A. H. Davison	2.25	468	9	.....do	1.69	210
7	.....do	2.32	503				

[illegible]

[illegible]

Day	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible] discharge of [illegible] River near [illegible] Mass., for the year ending [illegible]

Drainage area, [illegible] square miles.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
September	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
The year	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

HOUSATONIC RIVER AT FALLS VILLAGE, CONN.

Location.—About half a mile below power plant of Connecticut Power Co. at Falls Village, Litchfield County, 23 miles north of Gaylordsville.

Drainage area.—644 square miles (authority, Stone & Webster).

Records available.—July 11, 1912, to September 30, 1917.

Gages.—Stevens continuous water-stage recorder on left bank; staff and hook gages inside the well and vertical staff on river bank 25 feet upstream; chain gage 300 feet upstream used for auxiliary readings.

Discharge measurements.—Made by wading or from cable installed October 18, 1916, 150 feet above gage.

Channel and control.—Channel deep and fairly uniform in cross-section; one channel at all stages. Control not clearly defined except at low stages; probably permanent.

Extremes of discharge.—Maximum stage during year, from water-stage recorder, 10.40 feet at 10 a. m. March 29 (discharge, 6,000 second-feet); minimum stage, from water-stage recorder, 0.28 foot at 6.30 p. m. October 15 (discharge, practically zero).

1912–1917: Maximum stage recorded, 13.3 feet on March 29, 1914 (discharge, 8,830 second-feet); minimum stage recorded, zero flow at various times owing to storage of water above power plant.

Ice.—Stage-discharge relation seriously affected by ice.

Regulation.—Low-water flow completely regulated by the power plant at Falls Village.

Accuracy.—Stage-discharge relation practically permanent, except when affected by ice. Rating curve for chain gage well defined between 200 and 3,000 second-feet; above 3,000 second-feet, curve is extended by logarithmic plotting, using results of 3 float measurements made between gage heights 12 and 13 feet; rating table for gage heights from water-stage recorder derived from chain gage rating curve by applying correction for slope between the two gages. Operation of water-stage recorder satisfactory. Daily discharge ascertained by use of discharge integrator. Records excellent.

Cooperation.—All discharge measurements and computations prior to March 1, 1916, furnished by Stone & Webster.

Discharge measurements of Housatonic River at Falls Village, Conn., during the year ending Sept. 30, 1017.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	Sec.-ft.			Feet.	Sec.-ft.
Nov. 14	Hardin Thweatt	1.97	404	Mar. 29	Hardin Thweatt	10.41	6,020
14	do	1.96	410	29	do	10.42	6,300
Jan. 6	A. H. Davison	*a* 4.49	1,390	31	do	9.02	4,830
28	H. H. Khachadoorian	*a* 2.13	299	Aug. 10	M. R. Stackpole	2.58	626
Mar. 5	A. H. Davison	*a* 5.38	1,320				

a Stage discharge relation affected by ice.

Daily discharge, in second-feet, of Housatonic River near Great Barrington, Mass., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	220	205	1,270	335	335	1,130	1,810	570	570	485	92	[illegible]
2	260	190	1,060	380	380	720	2,740	458	512	540	160	[illegible]
3	260	190	485	295	315	570	2,830	720	315	380	190	[illegible]
4	300	220	512	335	205	430	2,380	720	315	98	175	[illegible]
5	190	62	430	405	430	815	1,890	690	380	205	63	[illegible]
6	175	112	540	570	295	600	1,650	630	540	220	135	[illegible]
6	160	160	380	458	315	275	1,650	850	720	190	92	[illegible]
8	132	205	512	540	358	405	1,200	815	990	135	87	[illegible]
9	116	300	485	630	150	570	1,200	850	660	255	190	[illegible]
10	140	280	335	660	135	458	920	780	430	255	175	[illegible]
11	190	140	295	630	135	190	920	600	690	190	83	[illegible]
12	150	190	600	405	190	630	780	600	815	205	58	[illegible]
13	120	175	570	485	135	720	720	458	750	255	135	[illegible]
14	150	190	358	780	160	660	690	458	660	255	175	[illegible]
15	116	280	380	1,530	220	600	570	540	720	255	175	92
16	190	260	405	1,240	380	660	630	485	630	175	108	69
17	140	240	190	1,100	160	750	600	358	485	160	160	122
18	130	220	295	920	87	720	600	458	430	295	160	122
19	160	73	405	750	512	660	600	295	485	380	85	105
20	175	205	335	458	295	512	815	155	380	458	85	101
21	205	220	405	160	205	600	990	275	380	295	175	115
22	160	220	335	458	190	750	1,060	238	380	358	71	75
23	140	190	720	238	315	690	990	358	275	295	81	98
24	160	240	540	315	600	1,490	815	430	255	275	138	79
25	160	550	430	255	122	1,890	720	485	275	255	135	130
26	175	365	512	238	335	2,290	600	380	295	190	71	145
27	175	240	512	190	720	2,650	570	190	335	238	112	[illegible]
28	150	175	540	77	1,340	4,200	570	295	405	145	130	205
29	57	365	458	358	......	4,100	458	690	458	87	140	220
30	122	850	380	275	......	3,190	485	750	380	220	130	69
31	160	......	275	190	......	2,130	......	630	......	190	145	......

NOTE.—Stage-discharge relation affected by ice Feb. 10-18; discharge determined from study of gage heights, observer's notes, and weather records.

Monthly discharge of Housatonic River near Great Barrington, Mass., for the year ending Sept. 30, 1917.

[Drainage area, 280 square miles.]

Month.	Discharge in second-feet.	
	Maximum.	Minimum.
October	300	[illegible]
November	850	[illegible]
December	[illegible]	[illegible]
January	[illegible]	[illegible]
February	[illegible]	[illegible]
March	[illegible]	[illegible]
April	[illegible]	[illegible]
May	[illegible]	[illegible]
June	[illegible]	[illegible]
July	[illegible]	[illegible]
August	[illegible]	[illegible]
September	[illegible]	[illegible]

HOUSATONIC RIVER AT FALLS VILLAGE, CONN.

Location.—About half a mile below power plant of [illegible] Falls Village, Litchfield County, 23 miles north of [illegible]

Drainage area.—644 square miles (authority, Stone & [illegible]

Records available.—July 11, 1912, to September 30, 1917.

Gages.—Stevens continuous water-stage recorder on left bank [illegible] inside the well and vertical staff on river bank 25 feet [illegible] feet upstream used for auxiliary readings.

Discharge measurements.—Made by wading or from cable [illegible] 1916, 150 feet above gage.

Channel and control.—Channel deep and fairly uniform [illegible] channel at all stages. Control not clearly defined [illegible] permanent.

Extremes of discharge.—Maximum stage during year [illegible] 10.40 feet at 10 a. m. March 29 (discharge, 6,000 second-feet) [illegible] water-stage recorder, 0.28 foot at 6.30 p. m. October 15 [illegible]

1912–1917: Maximum stage recorded, [illegible] 8,830 second-feet); minimum stage recorded [illegible] storage of water above power plant.

Ice.—Stage-discharge relation seriously affected by ice. [illegible]

Regulation.—Low-water flow completely regulated [illegible] Village. [illegible] ion,

Accuracy.—Stage-discharge relation practically permanent [illegible] ice. Rating curve for chain gage well defined [illegible] evious feet; above 3,000 second-feet, curve is extended [illegible] parallel results of 3 float measurements made [illegible] in winter, table for gage heights from water-stage recorder [illegible] plying mean curve by applying correction for slope [illegible] water-stage recorder satisfactory. Daily discharge [illegible] charge integrator. Records excellent.

Cooperation.—All discharge measurements [illegible] furnished by Stone & Webster.

Discharge measurements of Housatonic River at [illegible] ending [illegible]

Made by—	Gage height.	[illegible]
	Feet.	
Hardin Thweatt	[illegible]	
do	[illegible]	
A. H. Davison	[illegible]	
H. H. Khachadoorian	[illegible]	
A. H. Davison	[illegible]	

[illegible] ge, Conn., for the [illegible]

[illegible]	[illegible]	Day.	Oct.	Nov.	Dec.
		21	60	29	......
		22	44	30	......
		23	38	39	......
		24	33	258	......
		25	31	83	......
		26	30	57	......
	......	27	29	47	......
31	......	28	28	46	......
28	......	29	28	43	......
27	......	30	28	78	......
		31	28	......	......

[illegible] Bennetts Bridge, Conn., for the period Oct. 1 [illegible] Dec. 15, 1916.

[[illegible] area, 89.3 square miles.]

[illegible]	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	[illegible]imum.	Minimum.	Mean.	Per square mile.	
[illegible]	95	23	34.0	0.381	0.44
[illegible]	258	27	44.8	.502	.56
[illegible]	118	42	65.4	.732	.41

HUDSON RIVER BASIN.

HUDSON RIVER NEAR INDIAN LAKE, N. Y.

LOCATION.—About a mile below mouth of Cedar River, 1½ miles above mouth of Indian River and 4 miles northeast of Indian Lake village, Hamilton County.

DRAINAGE AREA.—4[illegible]3 square miles (measured on topographic maps).

RECORDS AVAILABLE.—August 20, 1916, to September 30, 1917.

GAGE.—Gurley printing water stage recorder on right bank. Inspected by John A. Bolton.

DISCHARGE MEASUREMENTS.—Made by wading or from cable about 100 yards below gage.

CHANNEL AND CONTROL.—Solid ledge overlain with coarse gravel; probably permanent.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water stage recorder, 9.57 feet at 11 a. m. June 12 (discharge, 13,500 second-feet); minimum stage from water stage recorder, 1.62 feet from 10 a. m. to 10 p. m. October 13 (discharge 100 second-feet).

ICE.—Stage-discharge relation affected by ice.

REGULATION.—Large diurnal fluctuation due to logging operations during spring months. Seasonal distribution of flow slightly affected by storage.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice from December to April and by backwater from logs June to September. Rating curve fairly well defined between 75 and 600 second-feet and well defined between 600 and 6,000 second-feet. Operation of water stage recorder satisfactory. Daily discharge ascertained by applying mean daily gage height to rating table except when fluctuation required mean of hourly discharge. Records good.

Discharge measurements of Hudson River near Indian Lake, N. Y., during the year ending Sept. 30, 1917.

Date.		Made by—	Gage height.	Discharge.	Date.		Made by—	Gage height.	Discharge.
			Feet.	*Sec.-ft.*				*Feet.*	*Sec.-ft.*
Jan.	3[illegible]	E. D. Burchard	2.44	[illegible]	May	5	E. D. Burchard	2.[illegible]	[illegible]
	25	A. H. Dawson	a1.71	[illegible]		5	do	4.3[illegible]	2,1[illegible]
Feb.	20	E. D. Burchard	a2.7[illegible]	[illegible]		6	do	6.1[illegible]	4,[illegible]
Mar.	17	A. H. Dawson	a3.4[illegible]	[illegible]		6	do	5.6[illegible]	3,7[illegible]
Apr.	14	E. D. Burchard	2.[illegible]	[illegible]		7	do	4.[illegible]	2,4[illegible]
	14	do	2.[illegible]	[illegible]	June	22	O. W. Hartwell	b4.13	1,[illegible]
May	4	do	5.[illegible]	3,[illegible]		23	do	b3.7[illegible]	1,44[illegible]
	4	do	5.[illegible]	3,[illegible]	Aug.	7	J. W. Moulton	b1.72	13[illegible]
	4	do	4.[illegible]	3,[illegible]		8	do	b1.60	111
	4	do	3.7[illegible]	[illegible]					

a Stage-discharge relation affected by ice.   b Logs on control.

Daily discharge, in second-feet, of Hudson River near Indian Lake, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	356	203	1,700	280	280	260	1,300	2,430	1,500	1,880	170	237
2	422	229	1,640	280	280	220	2,600	2,720	1,810	1,720	166	358
3	388	252	1,340	280	260	220	4,230	3,410	2,020	1,240	152	535
4	295	290	1,020	260	260	200	4,570	2,560	2,030	1,030	142	535
5	216	305	890	280	280	200	4,400	1,400	2,420	875	133	421
6	191	305	1,200	340	260	200	3,740	2,310	2,240	990	130	339
7	175	290	1,290	380	240	190	3,000	1,580	2,610	765	130	329
8	167	280	1,200	380	220	180	2,280	1,800	2,370	506	123	291
9	164	276	1,000	340	220	180	1,750	1,690	2,520	405	163	263
10	231	295	1,060	320	240	180	1,340	1,680	2,320	373	224	250
11	167	763	1,020	300	240	190	21,290	1,900	4,150	329	177	216
12	128	932	932	300	220	240	1,060	1,130	11,400	338	174	196
13	112	562	772	280	200	260	975	940	7,900	379	184	174
14	115	457	750	280	200	260	850	1,660	4,080	379	184	170
15	125	810	750	360	220	280	772	1,320	3,080	338	184	163
16	139	630	750	440	220	260	735	1,880	4,230	310	220	159
17	149	506	700	460	200	260	665	1,660	3,930	300	250	152
18	149	383	600	440	200	280	850	1,300	2,210	291	296	146
19	157	320	500	440	190	260	1,390	1,870	1,520	277	250	146
20	268	266	480	400	200	240	3,280	1,650	1,420	254	220	159
21	457	342	550	380	220	240	5,140	1,850	1,320	237	192	321
22	630	357	500	380	220	260	5,910	1,570	1,670	232	181	455
23	562	325	550	360	220	260	6,290	2,480	1,420	334	170	358
24	464	735	500	340	240	320	4,870	1,650	1,280	339	174	300
25	377	1,340	460	320	260	420	3,720	2,760	1,460	416	305	250
26	367	1,490	500	300	260	550	3,900	1,490	1,280	506	268	200
27	310	1,420	480	280	280	750	2,720	1,170	950	405	204	174
28	266	810	480	280	280	1,400	2,160	1,900	800	291	174	174
29	234	665	440	260	....	1,700	2,300	1,430	800	216	170	177
30	216	1,170	460	260	....	1,600	2,740	2,640	1,620	208	192	212
31	203	....	340	260	....	1,500	....	3,030	....	181	212	....

NOTE.—Discharge Oct. 10, 20, 21, Nov. 11, 14, 21, 22, 27, 30, Apr. 19 to June 12, and Sept. 21 is mean of 24 hourly determinations. Discharge Dec. 14 to Apr. 2 determined, because of ice, from discharge measurements, weather records, and study of gage-height graph. Discharge June 13 to Sept. 30 determined from special rating because of log jam on control.

Monthly discharge of Hudson River near Indian Lake, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 418 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	630	112	265	0.634	0.73
November	1,490	203	567	1.36	1.52
December	1,700	340	802	1.92	2.21
January	460	260	331	.792	.91
February	280	190	236	.565	.59
March	1,700	180	437	1.05	1.21
April	6,290	665	2,690	6.45	7.20
May	3,410	940	1,900	4.55	5.25
June	11,400	800	2,610	6.22	6.94
July	1,880	181	527	1.26	1.45
August	305	123	191	.457	.53
September	535	146	262	.627	.70
The year	11,400	112	900	2.15	29.24

HUDSON RIVER AT THURMAN, N. Y.

Location.—At Delaware & Hudson Railroad bridge near Thurman railroad station, Warren County, [illegible] a mile below mouth of Schroon River and 13 miles [illegible] of Sacandaga River.

Drainage area.—[illegible] square miles.

Records available.—September 1, 1907, to September 30, 1913.

Gage.—[illegible] on downstream side [illegible] read by S. H. Spencer.

Discharge measurements.—Made from downstream side of bridge.

Channel and control.—Bed composed of sand and gravel; fairly permanent.

Extremes of discharge.—Maximum stage recorded during year, 9.45 feet, about [illegible] m. June [illegible]; discharge, [illegible] second-feet; minimum stage recorded, 2.06 feet, about 7 a. m., November [illegible]; discharge about [illegible] second-feet.

1907–1913: Maximum stage, [illegible] feet, during the evening, March [illegible], 1913, determined by leveling from flood marks; discharge about [illegible],000 second-feet; minimum stage recorded, [illegible] feet, at [illegible] a. m. and [illegible] p. m., September 30, 1913; discharge about [illegible] second-feet.

Ice.—Stage-discharge relation seriously affected by ice. Winter discharge determined from records at North Creek and Riverbank.

Regulation.—Discharge is regulated to some extent by the storage reservoirs at Indian Lake and Schroon Lake and the mills on the Schroon River.

Accuracy.—Stage-discharge relation practically permanent; affected by ice during some part of the period from December to March, inclusive. Rating curve well defined between [illegible] and [illegible],000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good. Estimated discharge during ice period fair.

Cooperation.—Gage heights furnished by the International Paper Co.

Discharge measurements of Hudson River at Thurman, N. Y., during the year ending September 30, 1913.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	Sec.-ft.			Feet.	Sec.-ft.
Apr. [illegible]	[illegible]	[illegible]	[illegible]	June [illegible]	E. D. Burchard	[illegible]	[illegible]
[illegible]	E. D. Burchard	[illegible]	[illegible]	[illegible]	do.	[illegible]	[illegible]
May [illegible]	do.	[illegible]	[illegible]	Aug. [illegible]	[illegible]	[illegible]	[illegible]

a Stage-discharge relation affected by logging operations.

Daily discharge, in second-feet, of Hudson River at Thurman, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	805	850	3,860	9,500	5,290	8,100	4,140	1,150	1,380
2	905	850	3,860	11,400	8,100	4,140	3,860	1,080	1,460
3	1,080	960	3,200	12,100	6,780	4,710	4,710	1,150	1,380
4	1,380	1,080	2,720	12,500	4,140	4,560	3,330	1,020	1,300
5	1,080	960	2,370	12,100	4,710	4,420	2,960	960	1,640
6	1,080	1,020	2,840	11,400	5,580	5,000	2,960	960	1,640
7	1,020	1,020	2,840	10,200	3,860	5,290	2,960	960	1,460
8	960	905	2,840	9,140	5,000	4,140	2,150	1,080	1,380
9	1,020	805	2,600	7,760	4,140	4,710	2,150	1,300	960
10	960	850	2,600	6,470	6,780	4,140	1,940	1,740	1,220
11	1,020	850	2,480	5,870	5,580	4,710	1,460	1,550	1,220
12	905	1,460	2,370	5,580	5,000	22,600	1,460	1,380	1,220
13	1,220	1,460	2,260	5,000	2,720	19,800	1,460	1,380	1,220
14	905	1,080	1,740	4,420	3,590	13,700	1,220	1,300	1,150
15	760	1,150	1,740	4,140	2,370	11,000	1,150	1,550	1,080
16	720	1,460	1,300	3,860	4,420	11,000	1,080	1,640	1,150
17	610	1,220	1,150	3,590	2,720	11,000	1,020	1,460	1,380
18	578	1,080	....	3,860	5,290	8,100	1,080	1,300	1,300
19	680	805	....	4,710	2,150	6,780	1,150	1,300	1,460
20	1,150	720	....	7,760	3,080	6,170	1,460	1,220	1,300
21	1,080	578	....	12,100	1,840	5,870	1,460	960	1,460
22	1,380	515	....	14,100	6,170	5,000	1,300	960	1,740
23	1,220	645	....	13,700	1,940	5,000	1,150	1,150	1,640
24	960	2,150	....	11,700	6,470	5,000	960	1,550	1,550
25	850	3,460	....	10,200	2,840	3,590	1,150	1,380	1,550
26	720	2,840	....	9,860	8,440	3,200	1,080	1,380	1,380
27	720	4,420	....	7,430	3,330	2,960	1,740	1,150	1,300
28	680	2,150	....	5,870	3,200	2,600	1,550	960	1,380
29	610	1,740	....	6,470	4,140	2,600	1,020	1,150	1,150
30	850	2,370	....	5,000	5,000	3,590	905	1,380	1,300
31	960	....	....	....	5,000	....	850	1,300	....

NOTE.—Mean discharge Dec. 18–31, estimated because of ice, 1,350 second-feet from sum of flow at North Creek and Riverbank plus an estimated inflow.

Monthly discharge of Hudson River at Thurman, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 1,550 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,380	578	931	0.601	0.69
November	4,420	515	1,380	.890	.99
December	3,860	....	1,990	1.28	1.43
January	....	....	1,180	.761	.88
February	....	....	1,240	.800	.83
March	....	....	1,900	1.23	1.42
April	14,100	3,590	8,260	5.32	5.94
May	8,440	1,840	4,510	2.91	3.34
June	22,600	2,600	6,780	4.37	4.88
July	4,710	850	1,830	1.18	1.36
August	1,740	960	1,250	.806	.93
September	1,740	960	1,360	.877	.98
The year	22,600	515	2,710	1.75	23.67

NOTE.—Mean discharge for January, February, and March estimated, because of ice, from sum of flow at North Creek and Riverbank plus an estimated inflow. No correction has been made in this table for storage.

HUDSON RIVER AT SPIER FALLS, N. Y.

Location.—Half a mile below Spier Falls dam, Saratoga County, and 11½ miles below mouth of Sacandaga River.

Drainage area.—2,800 square miles (measured on topographic maps).

Records available.—October 7, 1912, to June 30, 1917.

Gage.—Gurley 2-day water stage recorder in brick shelter on the right bank. Recorder inspected by T. F. Malone, chief operator of power plant.

Discharge measurements.—Made from a cable about 1,000 feet downstream from the gage.

Channel and control.—Bed composed of coarse gravel and boulders. Control probably permanent.

Extremes of discharge.—Maximum stage during year, from water stage recorder, 12.82 feet, at 8.30 p. m. June 12 (discharge, 38,100 second-feet); minimum stage, minus 0.12 feet, at 4 p. m. September 23, observed during current meter measurement (discharge about 5.5 second-feet).

1912–1917: Maximum stage, from water stage recorder, 18.59 feet, at 12.25 a. m. March 28, 1913 (discharge about 89,100 second-feet); minimum stage, September 23, 1917.

Ice.—Stage-discharge relation not affected by ice except for a short time during extremely cold periods.

Regulation.—Large diurnal fluctuation in discharge due to operation of the Spier Falls power plant. Seasonal flow affected by storage at Indian Lake and many small lakes and reservoirs in the upper part of the drainage basin.

Accuracy.—Stage-discharge relation practically permanent; affected by ice February 2 to 16. Rating curve well defined for all stages except about 9 feet (discharge 19,900 second-feet), where curve may be 4 per cent or 5 per cent large. Operation of the water stage recorder satisfactory throughout the year. Daily discharge ascertained by averaging the results obtained by applying gage heights for one-hour intervals to the rating table. Records good.

Cooperation.—Water stage recorder inspected by an employee of the Adirondack Electric Power Corporation.

Discharge measurements of Hudson River at Spier Falls, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Feb. 24	E. D. Burchard	[a] 2.80	1,580
Apr. 10	.....do	7.77	14,200

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Hudson River at Spier Falls, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	513	1,400	9,310	1,430	2,350	2,790	18,000	12,000	12,100	8,490	1,360	1,930
2	1,470	1,450	9,840	1,700	2,340	3,070	22,800	13,200	7,830	8,640	1,810	906
3	1,160	1,460	8,890	1,990	1,790	2,800	27,800	13,400	7,670	8,330	2,260	1,220
4	1,540	1,740	7,540	1,820	1,840	2,020	29,400	13,600	7,600	6,140	1,150	2,740
5	2,120	1,320	6,530	2,550	2,440	3,280	28,600	11,900	7,280	5,220	506	2,060
6	1,590	1,960	6,490	2,670	2,260	2,290	26,200	11,600	8,450	4,420	1,950	2,260
7	1,110	1,680	7,100	1,330	2,180	2,460	23,500	11,000	7,450	4,050	1,330	2,670
8	674	1,560	6,720	2,950	1,950	2,490	20,400	10,900	7,210	3,520	831	2,500
9	1,550	1,910	6,020	2,640	2,410	2,290	17,600	9,930	8,300	3,720	1,500	1,010
10	1,320	1,690	6,170	2,600	2,290	2,390	15,100	9,820	8,250	2,720	2,240	1,240
11	1,040	2,140	6,350	2,660	1,260	1,330	12,900	8,770	9,800	2,230	2,200	947
12	958	1,480	5,700	2,520	2,010	2,290	11,600	8,360	31,900	2,630	1,650	1,480
13	1,440	2,930	5,050	2,190	1,980	2,300	10,600	7,480	36,000	2,490	2,240	1,500
14	1,620	1,830	4,230	1,440	1,550	2,460	9,580	6,680	30,400	2,520	1,660	1,440
15	1,080	1,920	3,090	3,450	1,880	2,500	8,860	5,530	24,400	2,420	1,930	1,720
16	959	2,040	3,180	3,620	2,090	2,840	8,230	6,620	21,500	2,870	1,980	1,050
17	1,190	2,160	1,380	4,020	1,850	2,430	7,610	5,180	20,300	2,250	2,290	1,540
18	810	1,550	2,460	4,050	2,000	1,660	7,940	5,520	15,200	2,000	1,980	1,500
19	991	1,190	2,360	4,030	2,090	3,970	9,570	4,200	12,900	2,000	1,260	1,500
20	1,600	1,900	2,440	3,490	1,970	2,600	14,600	6,380	10,400	2,330	1,900	1,940
21	2,570	1,220	2,380	2,820	1,950	2,730	22,700	4,570	9,320	2,000	1,320	1,700
22	2,520	1,150	2,700	3,550	1,730	2,880	26,000	4,850	8,220	2,060	1,360	2,360
23	3,370	848	2,970	2,620	2,080	3,060	28,300	4,000	7,630	2,720	1,560	909
24	2,750	2,510	1,300	2,410	1,630	2,890	26,700	7,250	5,810	1,900	2,220	970
25	2,170	6,450	2,040	2,530	1,460	5,340	23,100	6,090	6,070	1,530	2,550	1,710
26	1,540	6,690	2,540	2,440	2,420	8,300	20,000	9,480	6,070	1,560	1,010	1,490
27	1,600	5,370	1,890	1,870	1,940	12,200	17,600	6,140	4,940	2,080	2,620	1,890
28	1,520	5,500	1,850	1,510	2,320	18,100	15,100	5,200	4,310	2,770	1,560	1,720
29	1,020	5,140	2,390	2,040	....	18,400	13,800	6,290	4,630	1,420	1,360	1,320
30	1,570	5,770	2,530	1,800	....	19,000	12,600	9,390	7,670	1,490	2,000	1,000
31	1,670	....	1,400	2,140	....	18,400	....	11,100	....	1,160	2,250	....

NOTE.—Daily discharge Feb. 2-16, computed, because of ice, by comparison with the discharge determined from power house records at the Spier Falls plant. Discharge Sept. 8 estimated.

Monthly discharge of Hudson River at Spier Falls, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 2,800 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	3,370	513	1,520	0.543	0.63
November	5,770	848	2,530	.904	1.01
December	9,840	1,300	4,350	1.55	1.79
January	4,050	1,330	2,540	.907	1.05
February	2,440	1,260	2,000	.714	.74
March	19,000	1,330	5,210	1.86	2.14
April	29,400	7,610	17,900	6.40	7.14
May	13,600	4,000	8,270	2.95	3.40
June	36,000	4,310	12,000	4.27	4.76
July	8,640	1,160	3,220	1.15	1.33
August	2,620	506	1,740	.621	.72
September	2,740	906	1,610	.575	.64
The year	36,000	506	5,230	1.87	25.35

... prior to this time occurred April, 1869; calculated discharge, 70,000 seco...
... Paper 65, p. 81, and report of United States Board of Engineers on Deep Wate...

Monthly discharge of Hudson River at Mechanicville, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 4,500 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	4,140	a 1,330	2,240	0.498	0.57
November	11,300	a 2,020	4,020	.893	1.00
December	13,100	3,310	6,740	1.50	1.73
January	7,380	a 2,100	4,500	1.00	1.15
February	16,000	a 1,150	2,750	.611	.64
March	31,800	4,120	10,900	2.42	2.79
April	35,500	9,350	21,300	4.73	5.28
May	15,000	5,400	10,100	2.24	2.58
June	36,300	6,350	14,200	3.16	3.53
July	11,900	1,660	4,360	.969	1.12
August	2,970	1,250	1,870	.416	.48
September	3,380	a 899	1,770	.393	.44
The year	36,300	a 899	7,060	1.57	21.31

a Sunday.

NOTE.—Figures in this table do not include diversion into Champlain canal.

CEDAR RIVER NEAR INDIAN LAKE, N. Y.

LOCATION.—At steel highway bridge 2 miles west of Indian Lake village, Hamilton County, 8 miles by river above Rock River, 10 miles by river below Wakely dam, and about 12 miles above mouth of river.

DRAINAGE AREA.—85 square miles (measured on topographic maps).

RECORDS AVAILABLE.—July 15, 1911, to November 30, 1917, when station was discontinued.

GAGE.—Chain at downstream side of bridge; read by Chauncy Hill.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Gravel and large boulders; fairly permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 18.7 feet about midnight June 11 from watermarks observed by Mr. F. E. Wood (discharge not computed); minimum stage, 2.5 feet, October 12, 13, 14, and September 27 (discharge 20 second-feet).

1911–1917: Maximum stage recorded June 11, 1917; maximum discharge recorded, 3,700 second-feet, at 6 p. m., May 17, 1916 (gage height, 12.15 feet); minimum stage recorded, 2.10 feet at 4 p. m., September 27, 1915 (discharge, about 5 second-feet).

ICE.—Stage-discharge relation affected by ice.

REGULATION.—Cedar River flow is controlled by a lumberman's dam (Wakely dam), which is used to make flood waves during the spring for log driving.

ACCURACY.—Stage-discharge relation fairly permanent. Rating curve well defined, between 15 and 600 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good except for periods of log-driving operations in the spring.

Discharge measurements of [illegible] River near Indian Lake, N. Y., during the year ending [illegible], 1917.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		Feet.	Sec.-ft.			Feet.	Sec.-ft.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

Daily discharge, in second-feet, of [illegible] River near Indian Lake, N. Y., for the period [illegible], 1917.

Day.	[illegible]	[illegible]	[illegible]	May.	June.	July.	Aug.	Sept.
[illegible]								
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Day.	Oct.	Nov.	Day.	Oct.	Nov.	Day.	Oct.	Nov.
1917.			1917.			1917.		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

NOTE.—Discharge not determined because of ice, Dec. 1, 1916, to Mar. 31, 1917. Discharge Nov. 29 and 30, 1917, estimated because of ice.

Monthly discharge of Cedar River near Indian Lake, N. Y., for the period Oct. 1, 1916, to Nov. 30, 1917.

[Drainage area, 85 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1916.					
October	146	21	61.6	0.725	0.84
November	1,040	42	341	4.01	4.47
1917.					
April	2,900	114	959	11.28	12.59
May	2,650	174	665	8.06	9.29
June	4,250	184	622	7.32	8.17
July	538	33	129	1.51	1.74
August	68	27	37	.434	.50
September	74	20	39	.457	.51
October	2,010	27	217	2.55	2.94
November	1,640	25	214	2.52	2.81

NOTE.—No correction for storage.

INDIAN LAKE RESERVOIR AT INDIAN LAKE, N. Y.

LOCATION.—At masonry storage dam at outlet of Indian Lake, 2 miles south of Indian Lake village, Hamilton County, and 7½ miles above mouth of Indian River.

DRAINAGE AREA.—131 square miles, including about 9.3 square miles of water surface of Indian Lake at the elevation of crest of spillway (measured on topographic maps.

RECORDS AVAILABLE.—Records of stage and gate openings from July, 1900, to September 30, 1917.

GAGES.—Elevation of water surface in reservoir is determined by chain gage on the crest of dam near gate house. Gage installed November 17, 1911, to replace staff gage previously maintained at the same point; datum unchanged. Widths of sluice gate openings determined by gage scales at sides of gate stems inside gate house. Gages read by Lester Savarie.

EXTREMES OF STAGE.—Maximum elevation of water surface in reservoir, 37.55 feet June 13; minimum elevation, 8.7 feet March 25.

1900–1917: Maximum elevation recorded, 38.8 feet March 28, 1913; Minimum stage recorded, 2.0 feet March 9 to 18, 1907, and January 3 to 17, 1910.

REGULATION.—At ordinary stages the discharge is completely regulated by the operation of the sluice gates. Water is held in storage until needed to supplement the flow of the upper Hudson during the low water period. This storage capacity of about 4.7 billion cubic feet provides for a discharge of approximately 600 second-feet for a period of 90 days.

For record of discharge see "Indian River near Indian Lake, N. Y." (p. 126).

Daily gage height, in feet, of Indian Lake reservoir at Indian Lake, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
23	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
26	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
28	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
29	[illegible]	[illegible]	[illegible]	[illegible]	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30	[illegible]	[illegible]	[illegible]	[illegible]	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
31	[illegible]	......	[illegible]	[illegible]	......	[illegible]	......	[illegible]	......	[illegible]	[illegible]	......

Gate openings, in inches, at Indian Lake reservoir at Indian Lake, N. Y., for the year ending Sept. 30, 1917.

Dates inclusive.	Sluice gate A open.	Sluice gate B open.
	Inches.	Inches.
Oct. 1, 12 a. m. to Oct. 10, 5 p. m.	60	
[illegible]		[illegible]
[illegible]		60
[illegible]		60
[illegible]		30
[illegible]	[illegible]	
[illegible]		60
[illegible]	[illegible]	
[illegible]		30
[illegible]	60	
[illegible]		35
[illegible]		45
[illegible]		54
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	60	
[illegible]		30
[illegible]		30
[illegible]		30
[illegible]		[illegible]
[illegible]		45
Sept. 13, 5 p. m. to Sept. 30, 12 p. m.	60	

NOTE.—Main logway open 12 feet during the following periods: June 5, 5 a. m. to June 6, 9 a. m.; June 14, 5 a. m. to 5 p. m.; June [illegible] a. m. to [illegible] p. m.; June [illegible] a. m. to 5 p. m.; June 20, 8 a. m. to 5 p. m.; June 21, 4 a. m. to 5.30 p. m.; June 22, 5 a. m. to 11 a. m.; June 23, 7 a. m. to 7 p. m.

INDIAN RIVER NEAR INDIAN LAKE, N. Y.

LOCATION.—About three-fourths of a mile below dam at outlet of Indian Lake, 2 miles south of Indian Lake village, Hamilton County, 1 mile above mouth of Big Brook, and 6½ miles above mouth of Indian River.

DRAINAGE AREA.—132 square miles (measured on topographic maps).

RECORDS AVAILABLE.—July 1, 1912, to June 30, 1914; June 5, 1915, to September 30, 1917; also miscellaneous measurements in 1911.

GAGE.—Gurley repeating-hydrograph water-stage recorder; installed August 30, 1916, in a standard wooden shelter on the right bank three-fourths mile below dam, at same datum as staff gage previously used. The staff gage is still in place and used for checking the recorder. Recorder inspected by Lester Savarie.

DISCHARGE MEASUREMENTS.—Made from cable or by wading at the head of the rapids about 150 feet below the gage.

EXTREMES OF DISCHARGE.—Maximum stage, from water-stage recorder, 6.38 feet at 10.30 a. m., June 19 (discharge 2,410 second-feet); minimum stage, from water-stage recorder, 0.13 foot from 10 a. m. to 2 p. m., November 21 (discharge about 1.3 second-feet).

1912–1917: Maximum stage recorded, 7.8 feet at 4 p. m. March 28, 1913 (discharge about 3,460 second-feet); practically no flow when gates at Indian Lake are closed.

CHANNEL AND CONTROL.—The gage is at the side of a pool about 500 feet wide, called the "lower frog pond." The reef of coarse gravel at the outlet of this pool forms the control and is permanent.

ICE.—Stage-discharge relation not affected by ice.

REGULATION.—Discharge at this station is regulated by the operation of gates at the dam. (See Indian Lake Reservoir at Indian Lake, N. Y.)

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 15 and 1,500 second-feet. Daily discharge ascertained by applying mean daily gage height to rating table for days when there have been no changes in the sluice gate openings at Indian Lake dam. Mean daily gage height determined by inspection of the hydrograph record. Discharge for days when gate openings are changed is mean of 24 hourly discharge values.

The following discharge measurement was made by O. W. Hartwell:

June 21, 1917: Gage height 4.76 feet; discharge 1,400 second-feet.

Daily discharge, in second-feet, of Indian River near Indian Lake, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	220	372	7	242	471	453	4	5	281	418	545	573
2	286	372	4	296	471	453	14	7	292	453	526	316
3	623	372	4	489	471	453	15	7	298	418	526	313
4	623	326	3	375	471	436	8	7	286	392	526	307
5	623	372	4	142	453	436	7	8	1,320	363	508	304
6	623	338	4	6	453	436	5	9	691	331	508	252
7	603	211	3	4	453	422	4	5	819	301	716	9
8	603	213	3	30	453	408	3	4	298	281	810	65
9	603	217	3	237	453	394	3	4	316	250	810	284
10	584	214	4	237	436	379	2	4	331	237	810	271
11	584	214	3	234	436	375	2	4	468	227	788	275
12	564	214	2	234	436	371	2	5	1,100	224	767	389
13	545	214	2	232	443	367	2	5	1,510	224	767	453
14	299	214	2	232	545	363	2	6	1,880	217	746	453
15	170	214	2	230	545	359	2	6	1,800	207	746	535
16	172	217	2	230	526	356	2	7	1,430	196	482	725
17	168	217	2	227	526	353	2	8	1,320	252	415	725
18	409	147	69	227	526	334	4	9	1,180	489	385	704
19	392	4	259	224	508	328	6	10	1,230	471	385	704
20	7	2	259	224	508	322	12	10	1,360	453	382	704
21	5	53	259	222	489	322	9	9	1,220	288	448	684
22	3	148	259	222	489	318	7	23	796	129	664	684
23	2	277	261	220	489	314	147	267	997	131	664	684
24	2	369	256	220	489	310	5	266	526	133	664	684
25	2	375	253	220	471	310	3	79	369	135	664	684
26	2	225	253	224	471	269	3	108	240	137	462	664
27	2	5	253	222	471	63	3	133	212	135	341	664
28	164	3	250	222	453	15	3	352	424	133	547	643
29	375	3	247	220	....	8	3	295	212	131	623	643
30	375	11	244	220	....	3	4	222	348	182	623	623
31	372	....	242	261	....	3	....	264	....	564	623	....

Monthly discharge of Indian River near Indian Lake, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 132 square miles.]

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
October	623	2	323
November	375	2	204
December	261	2	110
January	489	4	220
February	545	436	479
March	453	3	314
April	147	2	9.60
May	352	4	69.3
June	1,880	212	768
July	564	131	274
August	810	341	596
September	725	9	501
The year	1,880	2	321

NOTE.—Figures showing monthly discharge in second-feet per square mile and run-off depth in inches are not published for this station on account of the effect of storage in Indian Lake Reservoir, for which no correction has been made.

SCHROON RIVER AT RIVERBANK, N. Y.

Location.—At the steel highway bridge near Riverbank post office, Warren County, near Tumblehead Falls, about 9 miles below Schroon Lake and about 9 miles above Warrensburg.

Drainage area.—534 square miles.

Records available.—September 2, 1907, to September 30, 1917.

Gage.—Chain, on upstream side of bridge; read by J. H. Roberts.

Discharge measurements.—Made from the upstream side of bridge.

Channel and control.—Gravel; occasionally shifting. Logs become lodged on the control at times nearly every year.

Extremes of discharge.—Maximum stage recorded during year, 6.5 feet from 4 p. m. April 4 to 4 p. m. April 6 (discharge about 4,630 second-feet); minimum stage recorded, 1.31 feet at 4 p. m. October 18 and 19 (discharge, 122 second-feet).

1907–1917: Maximum stage recorded, 10.7 feet at 5 p. m. March 28, 1913 (discharge about 13,500 second-feet); minimum stage recorded, 0.85 foot at 5 p. m. October 17, 1909 (discharge, 28 second-feet).

Ice.—Stage-discharge relation affected by ice.

Regulation.—Flow affected by storage in Schroon and Brant lakes.

Accuracy.—Stage-discharge relation probably permanent during year. Affected by ice for much of the period from December to March and by logs on the control for short periods in April, May, and June. Rating curve fairly well defined between 150 and 4,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good for periods when stage-discharge relation was not affected by ice or logs; fairly good for other periods.

Discharge measurements of Schroon River at Riverbank, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 8	E. D. Burchard	a2.26	391	Apr. 28	E. D. Burchard	4.73	2,230
29	A. H. Davison	a2.60	450	May 9	do	3.73	1,370
Feb. 22	E. D. Burchard	a2.35	273	9	do	3.75	1,380
Mar. 15	A. H. Davison	a2.30	286	June 15	do	5.91	3,680
Apr. 12	E. D. Burchard	4.94	2,400	15	do	5.89	3,670
12	W. A. James	4.91	2,270	Aug. 6	C. C. Covert	1.72	245

a Stage-discharge relation affected by ice.

SACANDAGA RIVER NEAR HOPE, N. Y

LOCATION.—About 1½ miles below junction of east and west branches, 3½ miles above Hope post office, Hamilton County, and 12 miles above Northville.

DRAINAGE AREA.—494 square miles (measured on topographic maps).

RECORDS AVAILABLE.—September 15, 1911, to September 30, 1917.

GAGE.—Staff in two sections, the lower inclined, the upper vertical; read by Melvin Willis.

DISCHARGE MEASUREMENTS.—Made from a cable about 100 feet below the gage or by wading

CHANNEL AND CONTROL.—Rocky; probably permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.35 feet at 6.20 p. m. June 11 (discharge 15,200 second-feet); minimum stage recorded, 1.49 feet at 6 p. m. September 29 (discharge 69 second-feet).

1911–1917: Maximum stage recorded, 10.0 feet at 5.30 p. m. March 27, 1913 (discharge, 24,800 second-feet); minimum stage recorded, 1.17 feet at 7.55 a. m. September 30, 1913 (discharge about 20 second-feet).

ICE.—Stage-discharge relation affected by ice.

ACCURACY.—Stage-discharge relation permanent; affected by ice during much of the period December to March, inclusive. Rating curve well defined between 60 and 10,000 second-feet. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good for periods when the stage-discharge relation is not affected by ice; fair for other periods.

Discharge measurements of Sacandaga River near Hope, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 9	A. H. Davison	2.44	421	Mar. 22	E. D. Burchard	[a] 4.75	622
9	.....do	2.43	431	June 7	.....do	3.37	1,230
Jan. 15	E. D. Burchard	[a] 6.84	951	7	.....do	3.33	1,190
Feb. 20	A. H. Davison	[a] 3.25	274	8	.....do	3.81	1,740

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Sacandaga River near Hope, N. Y., for the year ending Sept. 30, 1917.

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	[illegible]	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	[illegible]	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	[illegible]	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	[illegible]	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11	[illegible]	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	[illegible]	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	[illegible]	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	[illegible]	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15	[illegible]	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16	[illegible]	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17	[illegible]	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18	[illegible]	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
19	[illegible]	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20	[illegible]	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
21	[illegible]	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
22	[illegible]	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
23	[illegible]	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24	[illegible]	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
25	[illegible]	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
26	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
28	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
29	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
31	[illegible]	......	[illegible]	[illegible]	......	[illegible]	......	[illegible]	......	[illegible]	[illegible]	......

NOTE.—Mean discharge Nov. 5-25 estimated 416 second-feet. Discharge Dec. [illegible] to Mar. [illegible], inclusive, estimated because of ice, from discharge measurements, weather records, study of gage-height graph, and comparison with similar study for the station at Hadley.

Monthly discharge of Sacandaga River near Hope, N. Y., for the year ending Sept. 30, 1917.

[Drainage area 494 square miles.]

Month.	Discharge in second-feet. Maximum.	Minimum.	Mean.	Per square mile.	Run-off (depth in inches on drainage area).
October	[illegible]	130	429	0.868	[illegible]
November	[illegible]	....	764	1.55	[illegible]
December	[illegible]	340	929	1.88	[illegible]
January	[illegible]	300	544	1.10	[illegible]
February	[illegible]	200	422	.852	[illegible]
March	[illegible]	550	1,340	2.72	[illegible]
April	[illegible]	1,440	4,300	8.70	[illegible]
May	[illegible]	740	1,900	3.85	[illegible]
June	12,700	[illegible]	2,606	5.28	[illegible]
July	[illegible]	190	544	1.10	[illegible]
August	325	[illegible]	240	.486	.56
September	477	75	157	.318	.35
The year	12,700	75	1,230	2.49	[illegible]

SACANDAGA RIVER AT HADLEY, N. Y.

Location.—About half a mile west of railroad station at Hadley, Saratoga County, 1 mile above mouth of river and 4½ miles below site of proposed storage dam at Conklingville.

Drainage area.—1,060 square miles (measured on topographic maps).

Records available.—January 1, 1911, to September 30, 1917. September 13, 1907, to December 31, 1910, at upper bridge station; September 24, 1909, to August 31, 1911, at lower bridge station.

Gage.—Gurley graph water-stage recorder on the left bank, installed January 6, 1916, replacing a Barrett and Lawrence recorder. Recorder inspected by J. F. Kelly.

Discharge measurements.—Made from a cable about 30 feet above the gage, or by wading.

Channel and control.—Very rough but permanent.

Extremes of discharge.—Maximum stage recorded during year, from water stage recorder, 8.53 feet from noon until 10 p. m. April 4 (discharge, 12,800 second-feet); minimum stage, from water stage recorder, 2.58 feet at midnight September 27 (discharge, 169 second-feet).

Ice.—Stage-discharge relation seriously affected by ice.

Accuracy.—Stage-discharge relation permanent; affected by ice during a large part of period from December to March. Rating curve well defined between 150 and 20,000 second-feet. Operation of water stage recorder satisfactory throughout the year. Daily discharge ascertained by applying to the rating table mean daily gage height determined by inspecting gage-height graph. Records excellent for periods when the stage-discharge relation was not affected by ice; fairly good for other periods.

Discharge measurements of Sacandaga River at Hadley, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 9	E. D. Burchard	a 5.04	1,500	Apr. 16	E. D. Burchard	5.49	3,640
30	A. H. Davison	a 4.25	891	May 10	.....do	5.90	4,340
Feb. 23	E. D. Burchard	a 3.96	543	June 14	.....do	8.38	12,300
Mar. 20	A. H. Davison	a 4.97	1,460	14	.....do	8.33	12,100
Apr. 9	E. D. Burchard	6.93	7,480	Aug. 6	J. W. Moulton	2.81	278
11	.....do	6.37	5,740				

a Stage-discharge relation affected by ice.

[illegible]

[illegible] for the year ending Sept. [illegible]

[illegible] square miles.

Month.	Maximum.	Minimum.	Mean.	Per square mile.	Run-off depth in inches on drainage area.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
September	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
The year	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

HOOSIC RIVER NEAR EAGLE BRIDGE, N. Y.

LOCATION.—Half a mile below Walloomsac River and 1½ miles above Owl Kill and Eagle Bridge, Rensselaer County.

DRAINAGE AREA.—512 square miles (measured on topographic maps).

RECORDS AVAILABLE.—August 13, 1910, to September 30, 1917. September 25, 1903, to December 31, 1908, at Buskirk, 4 miles below present station.

GAGE.—Inclined staff on left bank near the farm house of James Russell. Prior to August 17, 1914, chain gage, 400 feet above present site; gage read by Mrs. Vashti Russell, Mrs. Viola Davis, and Mrs. Volney Russell.

DISCHARGE MEASUREMENTS.—Made from cable half mile below gage, or by wading.

CHANNEL AND CONTROL.—Gravel; somewhat shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.7 feet at 7.30 a. m., February 27 (discharge about 8,040 second-feet); minimum stage recorded, 2.68 feet at 6 a. m., September 24 (discharge about 44 second-feet).

1910–1917: Maximum stage not recorded, as gage used prior to August 17, 1914, could not be reached at high stages; minimum stage recorded, 6.1 feet at 5. p. m. September 14, 1913 (discharge practically zero).

ICE.—Stage-discharge relation affected by ice.

REGULATION.—Flow affected by storage on Walloomsac River and at Hoosick Falls about 2 miles above gage.

ACCURACY.—Stage-discharge relation probably permanent during year; affected by ice during much of period December to March, inclusive. Rating curve well defined between 75 and 7,000 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good except for periods of low water, when semi-daily gage heights may not indicate the true mean, and during periods when the stage-discharge relation is affected by ice; fair for the latter periods.

Discharge measurements of Hoosic River near Eagle Bridge, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 9	E. D. Burchard	3.22	209	Jan. 31	A. H. Davison	a 4.61	678
13	.....do	3.14	144	Feb. 24	.....do	a 4.19	290
13	.....do	3.08	127	Mar. 21	E. D. Burchard	4.30	734
13	.....do	2.99	98.6	21	.....do	4.33	760
13	.....do	2.94	95.9	June 6	.....do	4.74	1,090
Jan. 12	.....do	a 4.25	378				

a Stage-discharge relation affected by ice.

[illegible] discharge, in second-feet, of [illegible] River near Eagle Bridge, N. Y., for the year ending Sept. 30, [illegible]

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Note.—Discharge Dec. [illegible] and Jan. [illegible] to Feb. [illegible] estimated because of ice from discharge measurements, weather records and study of gage-height graph.

Monthly discharge of [illegible] River near Eagle Bridge, N. Y., for the year ending Sept. 30, [illegible].

[Drainage area, [illegible] square miles.]

Month	Discharge in second-feet				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	[illegible]	328	258	0.380	0.[illegible]
November	1,[illegible]	224	677	1.12	1.[illegible]
December	1,[illegible]	495	1,28[illegible]	2.11	2.[illegible]
January	2,[illegible]	40[illegible]	944	1.65	1.9[illegible]
February	[illegible]	2[illegible]	7[illegible]	1.50	1.5[illegible]
March	4,[illegible]	445	1,[illegible]	3.2[illegible]	3.7[illegible]
April	4,[illegible]	7[illegible]	1,[illegible]	3.71	4.14
May	[illegible]	565	1,[illegible]	1.9[illegible]	2.[illegible]
June	[illegible]	30[illegible]	7[illegible]	1.4[illegible]	1.6[illegible]
July	4[illegible]	159	25[illegible]	.4[illegible]	[illegible]
August	[illegible]	75	194	.3[illegible]	.4[illegible]
September	[illegible]	73	174	.3[illegible]	.3[illegible]
The year	[illegible]	73	7[illegible]	1.5[illegible]	2[illegible].1[illegible]

MOHAWK RIVER AT VISCHER FERRY DAM, N. Y.

Location.—At Vischer Ferry dam of Barge Canal (Lock No. 7), 1 mile above Stony Creek and Vischer Ferry, 7 miles below Schenectady, Schenectady County, and 11 miles above mouth.

Drainage area.—3,400 square miles (measured on topographic maps).

Records available.—June 24, 1913, to September 30, 1917.

Gage.—Stevens water-stage recorder (showing head on crest of spillway) in the southerly corner of the basin near upper end of Barge Canal lock, installed August 18, 1916; staff gage in masonry of outer lock wall, just above upper gates, read March 30 to May 23, 1914, and March 30 to August 17, 1916. Datum of staff gage 12.1 feet lower than that of recorder. Gurley water-stage recorder in the northerly (out-stream) corner of the basin, used December 17, 1913, to March 29, 1914, and May 24, 1914, to February 23, 1916. Inclined staff gage at foot of an old bridge abutment about 100 feet above Vischer Ferry, read June 24 to December 16, 1913, and May 24 to June 2, 1914. Water-stage recorder inspected by engineers from the Albany office of the United States Geological Survey; staff gage read by lock tenders.

Discharge measurements.—Made by wading below the dam at low-water during 1913–14. During the spring of 1915 the Crescent dam (next downstream) was closed, making further measurements impossible. No provision for measurements at medium and high stages.

Control.—The control is the crest of the spillway.

Extremes of discharge.—Maximum stage during year, from water-stage recorder, 4.07 feet at 9 a. m. June 12 (discharge, 51,500 second-feet); minimum stage, from water-stage recorder, 0.32 foot at 9 a. m. September 20 (discharge 800 second-feet).

1913–1917: Maximum stage recorded, 7.6 feet just before noon March 28, 1914, determined by leveling from flood marks (discharge not determined). This stage lasted but a few minutes and was caused by the breaking of an ice jam near Schenectady. Minimum stage from water-stage recorder, 0.18 foot from 4 a. m. to 5 a. m. and 4 p. m. to 6. p. m. October 31, 1914 (discharge about 290 second-feet).

Diversions.—Water was diverted into Erie canal at temporary lock in north end of dam prior to December, 1914. Measurements of this diversion were made at bridge 48, about a mile downstream, but no allowance for the diversion was made in computing the flow.

Barge Canal Lock No. 7, at the south end of dam was put in operation May 15, 1915. The following tables of discharge include the flow over the spillway, and through lock and water wheels.

Regulation.—Flow affected by operation of dams upstream.

Accuracy.—Stage-discharge relation practically permanent. Probably not affected by ice. Rating curve fairly well defined by discharge measurements between 350 and 2,500 second-feet; above 2,500 second-feet, based on theoretic coefficients. Gage in lock read to tenths twice daily January 29 to March 23; operation of water-stage recorder satisfactory for the remainder of year. Daily discharge ascertained from staff gage record by applying mean daily gage height to rating table; daily discharge for remainder of year determined by use of discharge integrator. Records fair.

Daily discharge, in second-feet, of Mohawk River at Vischer Ferry dam, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,750	1,460	18,200	3,380	4,670	14,200	16,200	7,670	6,870	11,400	2,260	3,480
2	1,960	1,190	12,500	3,380	5,120	10,100	30,000	11,000	7,310	8,920	2,240	2,960
3	2,150	881	9,840	4,220	4,670	7,520	32,400	11,800	5,920	7,140	1,420	2,510
4	1,320	952	7,330	5,120	3,780	6,020	25,400	10,400	5,910	5,780	2,030	1,730
5	1,200	1,760	10,100	5,120	3,380	5,120	21,700	10,200	4,360	4,530	2,550	2,520
6	1,500	2,420	11,700	5,930	3,380	4,220	18,200	16,400	4,680	3,510	1,330	2,120
7	2,090	3,130	10,600	6,720	3,380	4,220	20,300	13,500	4,830	3,720	1,430	2,310
8	1,240	3,700	8,070	7,520	3,380	4,220	17,000	12,300	11,800	3,550	1,730	2,040
9	1,130	2,590	8,320	7,120	3,380	4,220	13,600	10,500	13,300	3,430	1,980	1,520
10	1,440	3,040	10,300	6,820	2,580	4,670	10,500	9,570	12,100	4,590	3,380	2,050
11	1,090	3,560	10,000	6,620	2,580	4,670	8,920	8,690	13,600	5,120	3,260	2,020
12	955	2,400	7,800	6,120	2,580	4,220	8,520	8,370	48,300	7,570	1,850	2,120
13	977	2,230	7,030	6,220	2,580	11,800	8,620	7,540	36,600	6,350	2,020	2,250
14	1,120	3,570	5,390	5,840	2,580	10,600	8,620	6,810	23,800	4,940	2,400	2,220
15	1,570	3,720	5,450	5,700	2,580	9,020	7,420	5,620	17,400	6,790	2,830	1,520
16	919	3,720	7,030	7,620	2,580	8,020	6,720	5,040	11,500	8,020	1,980	2,400
17	1,440	2,950	3,160	7,020	2,580	7,520	5,660	7,090	10,400	4,730	2,060	1,600
18	907	3,390	2,690	5,840	2,220	8,020	5,930	5,480	8,390	4,320	2,390	1,770
19	1,170	2,980	3,460	4,940	1,870	8,020	6,610	5,100	5,910	5,330	1,660	2,100
20	2,270	3,310	3,540	4,580	1,870	6,520	10,200	5,270	6,340	4,130	1,630	1,360
21	4,780	3,860	3,860	4,040	1,870	5,570	17,100	4,780	9,740	4,150	1,720	1,990
22	5,760	3,300	4,270	3,780	1,870	6,020	18,700	4,930	7,520	3,350	1,640	1,580
23	3,780	2,670	4,760	3,780	1,870	9,900	17,700	4,910	5,240	3,290	1,620	1,510
24	2,380	8,060	5,480	3,780	1,870	20,800	14,900	4,660	6,880	2,630	2,590	1,470
25	2,820	14,300	5,300	3,700	1,870	39,200	11,600	4,770	7,640	2,430	6,760	1,660
26	1,790	9,740	4,040	3,380	1,870	41,000	9,120	4,890	6,110	2,080	4,230	1,440
27	2,160	6,720	4,130	3,140	2,220	47,400	8,320	4,830	7,880	2,790	2,780	1,640
28	2,020	5,520	4,580	3,140	16,200	46,400	6,670	5,130	7,370	2,350	2,230	1,560
29	1,320	5,840	4,400	2,580	....	30,800	5,350	9,430	7,200	2,180	6,140	1,490
30	1,000	15,100	4,220	2,980	....	22,400	5,650	15,900	14,900	1,700	2,520	1,960
31	1,070	....	4,220	4,220	....	16,500	....	10,400	....	2,120	2,790	....

NOTE.—See "Diversions" in station description.

Monthly discharge of Mohawk River at Vischer Ferry dam, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 3,400 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	5,760	907	1,870	0.550	0.63
November	15,100	881	4,270	1.26	1.41
December	18,200	2,690	6,830	2.01	2.32
January	7,620	2,580	4,980	1.46	1.68
February	16,200	1,870	3,260	.959	1.00
March	47,400	4,220	13,800	4.06	4.68
April	32,400	5,350	13,300	3.91	4.36
May	16,400	4,660	8,160	2.40	2.77
June	48,300	4,360	11,300	3.32	3.70
July	11,400	1,700	4,610	1.36	1.57
August	6,760	1,330	2,500	.735	.85
September	3,480	1,360	1,960	.576	.64
The year	48,300	881	6,420	1.89	25.61

DELAWARE RIVER BASIN.

EAST BRANCH OF DELAWARE RIVER AT FISH EDDY, N. Y.

LOCATION.—At railway bridge in village of Fish Eddy, Delaware County, about 4 miles below mouth of Beaver Kill and 5½ miles above confluence of East and West Branches.

DRAINAGE AREA.—790 square miles (measured on post-route map).

RECORDS AVAILABLE.—November 19, 1912, to September 30, 1917. Records were obtained at Hancock, about 4 miles below, from October 14, 1902, to December 31, 1912.

GAGE.—Staff, in two sections, on downstream end of left pier of railroad bridge; read by J. P. Lyons.

DISCHARGE MEASUREMENTS.—Made by wading or from the highway bridge about 200 feet above the gage.

CHANNEL AND CONTROL.—Coarse gravel; occasionally shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 12.3 feet at 8 a. m. March 28 (discharge about 18,100 second-feet); minimum stage recorded, 2.0 feet October 5 to 12 (discharge, 228 second-feet); minimum discharge, 95 second-feet, February 24 and 25 (stage-discharge relation affected by ice).

1912–1917: Maximum stage, 17.4 feet during the afternoon of March 27, 1913, determined by leveling from flood marks (discharge about 33,500 second-feet); minimum stage recorded, 1.64 feet at 5 p. m. October 12, 14, 15, 1914 (discharge 97 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation apparently permanent; affected by ice during much of the period from December to March, inclusive. Rating curve well defined between 200 and 20,000 second-feet. Gage read to hundredths twice daily October 1 to December 31 and July 1 to September 30; to tenths once daily, January 1 to June 30. Daily discharge ascertained by applying mean daily gage height to rating table. Records good except for periods when the stage-discharge relation was affected by ice, for which they are fair.

COOPERATION.—Gage-height record January 1 to June 30 furnished by United States Weather Bureau.

Discharge measurements of East Branch of Delaware River at Fish Eddy, N. Y., during the year ending Sept. 30, 1917.

[Made by E. D. Burchard.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Dec. 27	a 4.01	1,300
Jan. 24	a 6.06	798
Feb. 15	a 5.97	833
Mar. 10	a 5.33	860
Mar. 28	11.48	15,900
28	10.63	13,400

a Stage-discharge relation affected by ice.

S

charge, in

Day.	Oct.
1	2,750
2	1,960
3	2,150
4	1,320
5	1,200
6	1,50[illegible]
7	2,0[illegible]
8	1,2[illegible]
9	1,1[illegible]
10	1,4[illegible]
11	1,[illegible]
12	[illegible]
13	1,[illegible]
14	1,[illegible]
15	[illegible]
16	[illegible]
17	
18	
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20	
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22	
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30	
31	

NOTE.—S[illegible]

Monthly [illegible]

Monthly discharge of East Branch of Delaware River [illegible]

Month.	Maximum.	Minimum.
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	95
[illegible]	[illegible]	[illegible]
[illegible]	14,000	780
[illegible]	2,670	1,500
[illegible]	11,900	680
[illegible]	3,320	385
[illegible]	4,070	262
[illegible]	1,500	[illegible]
The year	18,100	95

DELAWARE RIVER AT PORT JERVIS, N. Y.

\t toll bridge at Port Jervis, Orange County, 1 mile above Neversink d 6 miles below Mongaup River.

REA.—3,250 square miles.

AILABLE.—October 12, 1904, to September 30, 1917.

f in two sections; the upper section vertical and attached to downstream ·ft abutment; the lower section inclined, about 30 feet downstream; read by ·lla Fuller. Prior to June 20, 1914, a chain gage on the bridge was used.

MEASUREMENTS.—Made from the bridge or by wading.

AND CONTROL.—Gravel; occasionally shifting.

OF DISCHARGE.—Maximum stage recorded during year, 11.3 feet at 8 a. m. 28 (discharge, 53,400 second-feet); minimum stage recorded, 1.6 feet, mber 27–30 (discharge 780 second-feet).

4–1917: Maximum stage recorded, 16.0 feet at 8 a. m. March 28, 1914 (dis-re, 92,700 second-feet); minimum stage recorded, 0.60 foot at 8 a. m. Septem-2 and 23, 1908 (discharge, 175 second-feet).

age-discharge relation somewhat affected by ice.

Y.—Stage-discharge relation practically permanent; affected by ice during e part of January and February. Rating curve well defined between 1,000 30,000 second-feet. Gage read to hundredths twice daily from October 1 December 31 and to tenths once daily, January 1 to September 30. Daily dis-urge ascertained by applying mean daily gage height to rating table. Records od for periods when the stage-discharge relation was not affected by ice and urly good for other periods.

RATION.—Gage-height record January 1 to September 30 furnished by United tates Weather Bureau.

arge measurements of Delaware River at Port Jervis, N. Y., during the year ending Sept. 30, 1917.

[Made by E. D. Burchard.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
b. 16	a 5.28	1,490
ar. 11	a 6.13	3,840
30	7.92	26,600

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Delaware River at Port Jervis, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
23	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
26	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
28	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
29	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
31	[illegible]		[illegible]	[illegible]		[illegible]		[illegible]		[illegible]	[illegible]	

NOTE.—Discharge [illegible] estimated, because of ice, from discharge measurements, weather records, study of gage-height graph, and comparison with similar studies for stations upstream.

Monthly discharge of Delaware River at Port Jervis, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, [illegible] square miles.]

Month.	Discharge in second-feet. Maximum.	Minimum.	Mean.	Per square mile.	Run-off (depth in inches on drainage area).
October	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
November	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
December	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
January	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
February	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
March	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
April	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
June	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
July	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
August	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
September	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
The year	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

DELAWARE RIVER AT RIEGELSVILLE, N. J.

LOCATION.—At [illegible] suspension bridge between Riegelsville, N. J., and Riegelsville, Pa., [illegible] feet above Musconetcong River and [illegible] miles below Lehigh River.

DRAINAGE AREA.—[illegible] square miles.

RECORDS AVAILABLE.—[illegible] 1906, to September 30, 1917.

GAGE.—Staff in three sections installed November 14, 1914, on left bank (New Jersey side) at upstream side of bridge; lower section inclined, middle and upper sections vertical. Prior to November 14, 1914, chain gage attached to upstream side of bridge. Gage read by J. H. Deemer to July 1, 1917, and after that date by Herbert J. Bernholz.

DISCHARGE MEASUREMENTS.—Made from bridge.

CHANNEL AND CONTROL.—Large bowlders; practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 18.1 feet at 4 p. m. March 28 (discharge, 88,400 second-feet); minimum stage recorded, 2.3 feet, September 30 (discharge, 1,990 second-feet).

1906–1916: Maximum stage[1] recorded, 25 feet March 28, 1913 (discharge, 144,000 second-feet); minimum stage recorded, 1.78 feet November 6, 1914 (discharge 1,170 second-feet).

ICE.—Discharge relation affected by ice, during severe winters only.

DIVERSIONS.—The Delaware division of the Pennsylvania canal diverts about 250 second-feet from Lehigh River near its mouth from about the last of March to the middle of December each year.

ACCURACY.—Stage discharge relation practically permanent; not seriously affected by ice during the year. Rating curve well defined. Gage read to quarter-tenths twice a day. Daily discharge obtained by applying mean daily gage heights to rating table. Records good.

The following discharge measurement was made by H. J. Jackson:

September 14, 1917: Gage height, 2.80 feet; discharge, 2,890 second-feet. Canal was measured also and discharge found to be 230 second-feet.

Daily discharge, in second-feet, of Delaware River at Riegelsville, N. J., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,940	3,280	10,900	6,850	8,820	9,500	29,300	7,170	10,900	15,000	4,420	8,150
2	3,160	3,390	16,300	6,850	8,820	10,500	35,100	7,490	10,500	12,400	5,010	6,850
3	3,390	3,390	11,600	6,850	5,610	11,600	47,700	8,480	13,100	11,200	5,610	6,230
4	3,160	3,160	10,200	7,490	5,310	9,500	42,500	7,820	12,000	11,600	3,880	5,310
5	2,940	3,280	8,820	8,820	6,540	8,150	31,000	8,480	11,200	9,840	3,390	4,710
6	2,730	3,280	8,150	16,700	4,420	6,230	31,600	10,900	10,500	8,150	3,390	4,140
7	2,530	3,160	7,490	15,800	5,310	6,230	30,400	13,900	11,600	7,490	3,390	3,880
8	2,530	3,160	6,850	17,100	5,310	7,170	29,300	13,500	14,200	6,850	3,880	4,140
9	2,630	3,390	6,230	14,600	5,610	8,820	23,500	13,100	18,400	6,850	9,840	7,170
10	2,250	3,160	6,850	13,100	3,880	9,500	21,600	13,900	16,300	8,480	11,200	3,880
11	2,160	3,050	6,850	12,000	4,420	11,600	18,800	13,100	17,100	9,840	9,500	3,630
12	2,160	2,940	6,850	7,490	3,880	19,700	16,700	12,000	28,800	13,100	8,480	3,390
13	2,080	3,390	6,850	6,850	3,880	16,300	15,800	10,500	47,000	15,000	8,150	3,280
14	2,080	3,390	5,610	14,600	4,140	16,300	15,400	9,840	30,400	12,700	7,170	3,160
15	2,160	3,160	5,310	22,100	4,140	18,000	14,200	9,500	27,700	13,500	5,920	2,940
16	2,080	2,940	4,140	23,500	4,710	15,800	13,100	8,480	28,800	12,000	7,170	2,730
17	2,160	3,050	3,630	20,700	3,880	15,400	12,000	7,820	23,000	10,500	7,820	2,530
18	2,250	3,160	3,390	15,400	3,880	17,100	10,900	7,820	19,300	11,600	6,230	2,630
19	2,440	2,840	3,880	13,900	4,420	13,900	10,500	7,490	15,800	8,820	5,610	2,340
20	5,010	2,840	3,630	11,200	4,420	12,000	11,200	6,850	14,200	7,820	5,310	2,440
21	9,840	2,840	4,140	10,200	4,420	11,200	11,200	6,540	15,000	7,170	4,710	2,340
22	7,490	2,730	5,310	12,700	4,710	10,900	13,100	6,230	13,900	6,850	4,710	2,340
23	8,480	2,730	8,820	12,700	3,880	11,600	12,700	5,610	12,000	7,490	4,140	1,990
24	6,850	3,630	10,900	9,840	10,200	15,400	11,200	5,920	10,900	7,170	5,920	2,080
25	5,610	5,310	12,400	9,500	8,480	45,700	10,500	5,610	12,700	6,850	5,610	1,990
26	5,010	6,850	10,900	7,490	6,230	56,000	9,500	5,610	11,600	6,850	9,840	1,990
27	4,420	6,540	9,840	6,540	6,230	58,100	8,820	5,310	10,900	6,230	7,820	2,080
28	4,140	5,010	9,160	7,170	8,150	86,100	8,480	5,310	18,800	6,920	5,920	1,990
29	3,880	4,710	9,500	6,850	....	78,600	8,150	7,490	19,300	5,610	5,010	2,080
30	3,630	6,230	8,150	9,500	....	51,800	7,820	11,200	15,400	5,010	5,010	1,990
31	3,630	....	6,850	10,900	....	39,300	....	12,700	....	4,710	5,610	....

[1] It has been estimated that the flood of October 10–11, 1903, reached a stage of 41.5 feet with a corresponding discharge of 275,000 second-feet.

Monthly discharge of Delaware River at Riegelsville, N. J., for the year ending Sept. 30, 1917.

[Drainage area, 6,430 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	9,840	2,080	3,740	0.617	0.71
November	6,850	2,730	3,670	.607	.68
December	16,300	3,390	7,730	1.22	1.41
January	23,500	6,540	11,800	1.84	2.12
February	10,200	3,880	5,490	.854	.89
March	86,100	6,230	22,800	3.58	4.13
April	47,700	7,820	18,700	2.95	3.29
May	13,900	5,310	8,890	1.42	1.64
June	47,000	10,500	17,400	2.74	3.06
July	15,000	4,710	9,120	1.45	1.67
August	11,200	3,390	6,120	.988	1.14
September	8,150	1,990	3,480	.577	.64
The year	86,100	1,990	9,940	1.57	21.38

NOTE.—To allow for water diverted by the canal, 230 second-feet was added to the daily discharge, Oct. 1 to Dec. 20 and Mar. 17 to Sept. 30, before computing discharge per square mile; first three columns of table therefore indicate actual quantity of water flowing in the river; the two remaining columns represent the total run-off from drainage area above Riegelsville, including the discharge of the canal.

BEAVER KILL AT COOKS FALLS, N. Y.

LOCATION.—At covered highway bridge in Cooks Falls, Delaware County.

DRAINAGE AREA.—236 square miles (measured on post-route and topographic maps).

RECORDS AVAILABLE.—July 25, 1913, to September 30, 1917.

GAGE.—Vertical staff, in two sections, bolted to rock on left bank under the bridge; read by J. L. Rosa and Ralph Rosa.

DISCHARGE MEASUREMENTS.—Made from the bridge or by wading a short distance downstream.

CHANNEL AND CONTROL.—Coarse gravel, boulders, and solid ledge; practically permanent.

EXTREMES OF DISCHARGE.—1913–1917: Maximum stage, determined from water marks on gage, 11.0 feet, some time during the night of March 27–28, 1917 (discharge about 7,870 second-feet); minimum stage recorded, 0.70 foot from 7 a. m. October 12 to 7 a. m. October 13, 1916 (discharge, 26 second-feet).

ICE.—Stage-discharge relation somewhat affected by ice.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice during portions of the period December to March, inclusive. Rating curve well defined between 50 and 4,500 second-feet. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good for periods when the stage-discharge relation was not affected by ice; fair for other periods.

Discharge measurements of Beaver Kill at Cooks Falls, N. Y., during the year ending Sept. 30, 1917.

[Made by E. D. Burchard.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Jan. 24	a 2.03	257	Mar. 10	a 2.85	317
Feb. 15	a 4.04	147	29	6.00	2,570

a Stage-discharge relation affected by ice.

y discharge, in second-feet, of Beaver Kill at Cooks Falls, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
	130	154	1,140	296	260	750	3,950	705	455	755	232	806
	92	124	1,020	256	190	440	4,550	705	420	1,200	232	530
	78	92	805	232	160	240	3,310	615	420	910	256	455
	65	75	755	296	150	280	2,720	805	355	615	244	455
	59	164	705	387	140	400	2,240	910	855	530	232	371
	48	208	660	755	130	300	2,020	855	1,590	455	232	296
	46	175	530	570	130	300	1,800	805	1,020	387	220	256
	38	164	455	455	150	400	1,330	805	805	355	232	256
	36	150	455	387	240	340	1,140	805	855	660	660	256
	31	244	455	387	260	300	910	705	755	2,720	455	269
	28	208	387	282	220	300	855	615	1,460	3,310	387	256
	26	175	371	256	170	650	965	570	3,220	2,960	244	232
	31	154	355	220	160	700	1,020	530	1,660	1,870	208	208
	154	154	340	1,520	150	650	910	490	1,400	805	186	186
	130	150	296	1,140	140	550	805	455	1,020	615	175	175
	100	134	280	755	110	480	705	455	1,520	530	910	164
	118	124	240	530	90	420	705	455	1,200	530	1,140	164
	70	114	200	455	80	400	855	371	965	530	530	144
	78	144	180	400	75	380	1,200	340	755	530	355	134
	805	134	170	360	90	355	1,590	325	615	455	310	124
	705	134	175	320	75	455	1,460	310	660	420	282	114
	530	154	530	360	90	420	1,330	310	420	340	387	114
	325	1,020	805	300	110	570	1,020	296	530	855	2,320	124
	256	2,480	530	260	220	2,400	855	282	420	660	1,080	114
	220	1,020	371	320	260	2,160	705	269	355	490	755	124
	197	755	387	300	320	3,140	615	244	387	420	455	114
	175	615	420	260	900	4,150	615	296	1,940	282	282	114
	175	570	387	240	1,300	4,650	570	325	1,400	256	1,520	164
	138	1,020	355	260	......	2,560	530	705	855	340	2,880	144
	114	1,400	325	280	......	1,940	615	530	1,140	310	910	186
1	98	......	296	220	......	2,020	......	490	......	256	1,080	......

NOTE.—Discharge Dec. 16-20 and Jan. 19 to Mar. 19, both inclusive, estimated because of ice, from dis-harge measurements, weather records, study of gage height graph, and comparison with similar studies rom near-by stations.

Monthly discharge of Beaver Kill at Cooks Falls, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 236 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	805	26	164	0.695	0.80
November	2,480	75	407	1.72	1.92
December	1,140	170	464	1.97	2.27
January	1,520	220	421	1.78	2.05
February	1,300	75	228	.966	1.01
March	4,650	240	1,070	4.53	5.22
April	4,550	530	1,400	5.93	6.62
May	910	244	528	2.24	2.58
June	3,220	355	982	4.16	4.64
July	3,310	256	818	3.47	4.00
August	2,880	175	626	2.65	3.06
September	805	114	235	.996	1.11
The year	4,650	26	613	2.60	35.28

aily discharge, in second-feet, of West Branch of Delaware River at Hale Eddy, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
	720	365	2,620	480	440	1,900	4,280	785	1,330	1,870	410	720
	480	480	2,050	480	380	1,100	7,240	720	1,780	2,620	410	605
	410	388	1,780	550	320	700	6,520	720	1,690	2,050	365	530
	388	855	1,690	500	100	550	5,680	720	1,510	1,510	388	432
	325	365	1,600	500	110	480	3,140	1,000	1,160	1,420	285	365
	305	505	1,330	2,200	140	360	3,030	1,870	1,330	1,240	285	325
	232	432	1,160	2,400	200	460	3,740	1,870	4,580	1,000	285	325
	215	388	1,000	1,700	220	420	2,620	1,960	5,200	855	232	325
	215	345	925	1,500	300	700	2,520	2,420	4,000	720	432	530
	185	455	1,330	1,400	260	850	1,870	1,960	3,030	855	720	365
	200	505	925	950	170	850	1,600	1,870	4,000	1,000	530	285
	179	432	700	650	160	2,200	1,690	1,690	6,180	1,870	365	250
	170	410	600	1,100	110	4,200	1,600	1,510	4,140	1,160	305	285
	305	410	500	2,400	200	2,600	1,510	1,330	3,250	1,160	285	250
	325	555	460	3,800	95	2,000	1,330	1,160	3,250	785	388	215
	250	455	380	2,800	120	1,600	1,160	925	2,620	720	388	250
	215	432	340	2,400	70	1,900	1,160	1,000	2,320	720	388	200
	215	388	320	2,000	75	2,000	1,000	785	1,870	660	480	200
	232	388	300	1,700	95	1,700	925	720	2,230	855	410	185
	285	455	300	1,500	90	1,800	1,240	720	1,690	855	325	155
	1,510	432	360	1,300	85	1,900	1,160	605	2,420	855	268	185
	1,330	325	440	1,100	65	2,000	1,420	605	1,690	855	285	185
	855	285	1,200	900	65	3,400	1,240	605	1,420	605	268	185
	720	1,510	1,200	700	90	7,500	1,160	555	1,600	580	530	170
	605	1,330	1,300	600	85	6,010	1,000	505	1,330	1,160	1,330	142
	580	785	1,000	500	160	6,180	855	530	1,160	785	660	142
	505	720	900	260	1,100	8,000	855	505	5,520	605	505	155
	455	855	900	100	3,600	10,500	720	660	3,030	530	410	142
	410	1,000	650	300	....	5,680	720	1,690	3,030	480	345	130
	365	2,620	440	380	....	4,000	720	1,870	2,520	720	720	105
	345	....	380	420	....	3,030	....	1,420	....	555	925	....

NOTE.—Discharge, Dec. 12 to Mar. 24, estimated, because of ice, from discharge measurements, weather cords, study of gage-height graph, and comparison with similar studies for near-by stations.

onthly discharge of West Branch of Delaware River at Hale Eddy, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 611 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
ctober	1,510	170	436	0.714	0.82
ovember	2,620	285	629	1.03	1.15
ecember	2,620	300	939	1.54	1.78
anuary	3,800	100	1,210	1.98	2.28
ebruary	3,600	65	318	.520	.54
arch	10,500	360	2,790	4.57	5.27
pril	7,240	720	2,120	3.47	3.87
ay	2,420	505	1,140	1.87	2.16
une	6,180	1,160	2,700	4.42	4.93
uly	2,620	555	1,020	1.67	1.93
ugust	1,330	232	449	.735	.85
eptember	720	105	278	.455	.51
The year	10,500	65	1,180	1.93	26.09

SUSQUEHANNA RIVER BASIN.

SUSQUEHANNA RIVER AT CONKLIN, N. Y.

Location.—At steel highway bridge just below Conklin, Broome County, 5 mil below Big Snake Creek and 8 miles above Chenango River.

Drainage area.—2,350 square miles.

Records available.—November 13, 1912, to September 30, 1917. Records we obtained at Binghamton, 8 miles below, from July 31, 1901, to December 31, 191

Gage.—Stevens water-stage recorder on left bank, just below the bridge, installe October 4, 1914. Prior to that date, staff in two sections, the lower sectic inclined; the upper vertical, attached to left abutment. Water-stage record inspected by Mrs. Cora Ames.

Discharge measurements.—Made from the bridge or by wading.

Channel and control.—Coarse gravel and boulders; probably permanent.

Extremes of discharge.—Maximum stage during year, from water-stage recorde 13.55 feet at 3 a. m. March 28 (discharge, 28,700 second-feet); minimum stag from water-stage recorder, 2.45 feet September 27 and 30 (discharge 500 secon feet).

Ice.—Stage-discharge relation affected by ice.

Accuracy.—Stage-discharge relation practically permanent. Affected by ice for large portion of the period from January to March, inclusive. Rating curv well defined between 250 and 55,000 second-feet. Operation of water-stag recorder fairly satisfactory, except December 9–22, April 30 to May 12 and Jun 27 to July 17; staff gage read to hundredths twice daily December 9–22 an July 4 to 17. Daily discharge ascertained by applying mean daily gage heigh to rating table, except for days when the mean gage height would not give th true discharge within 1 per cent. For such days the discharge is the mean of 2 hourly determinations. Gage heights obtained by inspecting gage-height grap or by taking mean of two observations per day. Records good except fo periods when the stage-discharge relation was affected by ice, for which the are fair.

Discharge measurements of Susquehanna River at Conklin, N. Y., during the year endin Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 3	E. D. Burchard	3.89	1,800	Mar. 9	E. D. Burchard	[a]7.06	2,18
Dec. 28	.....do	[a]4.69	2,780	31	.....do	8.22	11,00
Jan. 20	.....do	[a]5.70	3,620	May 14	C. C. Covert	5.38	4,20
Feb. 13	.....do	[a]5.84	1,180	June 2	E. D. Burchard	5.99	5,30
Mar. 6	.....do	[a]7.56	2,140				

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Susquehanna River at Conklin, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,910	1,230	7,330	2,200	2,600	10,000	11,500	2,830	4,760	8,760	2,210	1,750
2	2,280	1,400	6,400	1,800	2,400	7,000	13,400	2,830	5,940	8,280	1,880	1,520
3	1,810	1,750	4,840	2,000	2,000	4,600	12,300	2,830	5,060	9,500	1,750	1,880
4	1,570	1,520	4,140	2,200	1,800	2,600	14,300	2,830	4,230	7,330	2,070	1,520
5	1,400	1,460	3,860	3,000	1,600	2,400	10,800	2,910	3,500	5,940	1,750	1,280
6	1,300	1,570	4,040	6,000	1,500	2,200	9,500	5,940	3,240	4,640	1,520	1,150
7	1,170	1,940	3,950	7,500	1,400	2,200	11,000	5,940	9,180	3,860	1,400	1,050
8	1,100	1,750	3,500	5,500	1,300	1,900	9,740	5,940	10,000	2,670	1,350	1,080
9	1,020	1,570	2,990	4,200	1,400	2,200	8,040	5,940	10,800	3,420	3,580	1,150
10	970	1,630	3,420	3,800	1,400	2,600	7,100	5,940	8,760	2,990	7,240	1,350
11	930	1,880	3,860	3,800	1,300	2,800	5,940	5,940	7,800	2,830	5,560	1,180
12	882	2,070	3,330	3,000	1,300	8,500	5,500	5,940	10,800	3,860	3,240	1,060
13	826	1,890	2,990	1,800	1,200	12,000	5,500	4,530	12,800	4,640	2,280	946
14	946	1,750	2,800	2,200	1,100	12,000	5,280	4,230	10,200	3,860	2,360	882
15	1,090	2,250	2,400	3,800	950	9,500	4,640	3,680	9,000	4,230	1,940	810
16	1,250	2,830	2,200	6,500	900	6,500	4,140	3,240	8,760	5,720	1,880	747
17	1,040	2,360	2,200	5,500	850	5,500	3,860	3,080	7,800	5,720	2,910	754
18	938	2,140	2,000	4,400	850	5,000	3,500	3,160	6,400	4,950	2,360	691
19	997	2,070	2,000	4,000	800	4,200	3,330	2,830	6,400	5,060	1,810	649
20	2,360	2,000	1,900	3,600	800	3,200	3,420	2,510	7,020	6,700	1,460	600
21	4,040	2,000	1,800	3,200	800	3,000	4,230	2,510	10,800	6,860	1,300	600
22	3,240	2,000	2,200	3,200	800	3,200	4,230	2,440	9,000	5,720	1,150	579
23	2,590	1,750	3,000	3,000	800	12,000	3,680	2,440	6,400	4,530	1,060	530
24	2,210	2,740	3,800	2,800	800	11,000	3,420	2,670	5,940	4,040	1,570	500
25	1,940	5,940	3,400	2,400	800	20,000	3,080	2,590	6,860	3,240	1,860	518
26	1.810	4,740	3,800	2,200	800	21,000	2,750	2,440	6,630	3,590	2,300	512
27	1.630	3,080	3,200	2,000	900	24,800	2,750	2,360	11,400	2,830	1,520	500
28	1.570	2,910	2,800	1,900	4,400	27,600	2,750	2,670	11,400	2,360	1,210	506
29	1.350	2,910	2,600	1,800	......	24,400	2,590	6,450	11,400	2,280	1,180	506
30	1,350	4,480	2,200	1,800	......	16,800	2,510	7,800	11,400	2,280	1,630	500
31	1,300	......	2,000	2,200	......	12,100	......	5,940	......	2,990	2,070	......

NOTE.—Dischargo Dec. 14 to Mar. 26, estimated, because of ice, from discharge measurements, weather records and study of gage-height graph.

Monthly discharge of Susquehanna River at Conklin, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 2,350 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	4,040	826	1,610	0.685	0.79
November	5,940	1,230	2,320	.987	1.10
December	7,330	1,800	3,260	1.39	1.60
January	7,500	1,800	3,330	1.42	1.64
February	4,400	800	1,340	.571	.59
March	27,600	1,900	9,120	3.88	4.47
April	14,300	2,510	6,120	2.60	2.90
May	7,800	2,360	3,980	1.69	1.95
June	....	3,240	8,120	3.46	3.86
July	9,500	2,280	4,700	2.00	2.31
August	7,240	1,060	2,170	.924	1.07
September	1,880	500	910	.387	.43
The year	27,600	500	3,940	1.68	22.71

CHENANGO RIVER NEAR CHENANGO FORKS, N. Y.

Location.—About 1½ miles below Tioughnioga River, 2 miles by road below Chenango Forks post office, Broome County, and 11½ miles above Binghamton and the mouth.

Drainage area.—1,380 square miles (revised). See "Diversions."

Records available.—November 11, 1912, to September 30, 1917. Records were obtained at Binghamton, July 31, 1901, to December 31, 1911.

Gage.—Stevens water-stage recorder on the left bank on the farm of Erastus Ingraham.

Discharge measurements.—Made from cable, about 100 feet above the gage, or by wading.

Channel and control.—Sand, gravel, and small cobblestones; practically permanent.

Extremes of discharge.—Maximum stage during year, from water stage recorder, 11.16 feet at 4 a. m. March 28 (discharge, 23,600 second-feet); minimum stage, from water stage recorder, 2.74 feet at 2 a. m. October 13 (discharge, 345 second-feet).

1901–1917: Maximum stage recorded, 12.18 feet from noon until 1 p. m. April 2, 1916 (discharge, 27,900 second-feet); minimum stage recorded, 4.6 feet at the former station in Binghamton at 8 a. m. August 29, 1909 (discharge about 10 second-feet).

Ice.—Stage-discharge relation affected by ice.

Diversions.—The run-off from 87.3 square miles at head of Chenango River and from 15.7 square miles at head of Tioughnioga River is stored in reservoirs and, except for discharge over the spillways, is diverted out of the drainage area through the Erie Canal. The above-mentioned drainage area for Chenango River does not include these two areas.

Accuracy.—Stage-discharge relation practically permanent; affected by ice for a large part of the period from January to March, inclusive. Rating curve well defined between 120 and 35,000 second-feet. Operation of water-stage recorder fairly satisfactory throughout the year. Daily discharge ascertained by applying to the rating table mean daily gage heights, determined by inspecting gage-height graph or for days of considerable fluctuation, by averaging the hourly discharge. Records good except for periods when stage-discharge relation was affected by ice, for which they are fair.

Discharge measurements of Chenango River near Chenango Forks, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 29	E. D. Burchard	a 6.39	1,290	Apr. 2	E. D. Burchard	8.28	12,400
Jan. 22	.....do	a 5.12	1,670	May 14	C. C. Covert	4.30	2,290
Feb. 12	.....do	a 4.39	605	June 4	E. D. Burchard	4.54	2,680
Mar. 8	.....do	a 5.33	1,550				

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Chenango River near Chenango Forks, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,640	872	3,520	650	1,900	4,000	8,830	1,740	3,650	5,800	1,030	1,880
2	1,070	1,230	2,610	850	1,500	3,000	12,100	1,940	4,170	8,420	915	2,360
3	838	1,050	2,180	700	900	2,400	12,700	1,940	3,350	9,200	1,250	1,940
4	700	959	2,020	1,000	850	2,200	9,610	1,860	2,790	5,920	1,180	1,520
5	593	1,070	2,360	2,400	900	1,900	6,830	2,240	2,360	4,390	915	1,280
6	521	1,430	2,520	6,000	850	1,900	2,180	5,550	2,440	3,650	816	1,260
7	454	1,280	2,180	5,000	850	1,600	8,210	4,840	6,390	3,450	750	1,450
8	430	1,120	1,940	3,800	850	1,500	6,440	3,860	8,500	2,610	732	1,750
9	406	1,010	1,720	3,000	850	1,600	5,430	3,750	8,800	2,440	7,670	1,860
10	398	1,450	2,100	2,800	700	1,600	4,280	3,350	7,370	2,610	6,100	1,430
11	390	1,680	1,780	2,000	650	1,800	3,650	2,790	10,800	2,700	2,840	1,230
12	368	1,270	1,570	900	600	1,900	3,750	2,520	14,600	3,060	1,940	1,090
13	368	1,120	1,500	1,200	550	6,000	3,860	2,440	10,600	3,060	1,540	970
14	642	1,580	1,420	2,600	550	5,500	3,350	2,270	7,930	2,880	2,650	915
15	882	2,100	1,270	5,500	550	4,000	2,970	1,940	7,370	4,590	2,770	840
16	690	1,640	1,140	4,400	550	3,200	2,790	1,660	7,370	3,960	3,610	760
17	593	1,450	1,100	3,200	550	3,200	2,520	1,720	6,180	2,790	2,670	740
18	584	1,390	1,000	2,600	600	3,200	2,270	1,660	4,960	3,160	1,860	710
19	546	1.420	950	2,200	600	2,400	2,180	1,520	5,920	4,070	1,430	660
20	829	1,460	900	1,800	600	2,000	2,700	1,490	5,820	3,060	1,220	930
21	3,580	1,410	950	1,700	600	3,200	3,060	1,700	11,500	3,790	1,090	840
22	2,930	1,120	1,100	1,600	550	4,000	2,610	1,740	8,500	2,700	970	720
23	1,860	1,080	1,600	1,500	550	8,000	2,270	2,180	7,100	2,190	926	650
24	1,450	4,080	1,900	1,400	550	13,000	2,100	1,940	9,200	1,740	6,800	631
25	1,190	3,980	2,100	1,400	550	19,000	1,780	1,940	8,900	1,660	6,420	612
26	1,040	2,360	2,000	1,200	600	19,000	1,630	1,940	5,920	1,390	3,030	574
27	937	2,100	1,700	900	1,900	21,000	1,780	1,860	12,900	1,250	2,020	538
28	838	1,860	1,600	1,060	4,400	22,200	1,780	2,700	11,300	1,130	1,680	521
29	761	1,940	1,200	900	....	15,000	1,690	7,510	7,980	1,340	2,100	538
30	700	3,500	900	1,200	....	9,730	1,600	6,960	8,510	1,690	2,270	564
31	670	....	700	2,000	....	7,730	....	4,610	....	1,270	2,020	....

NOTE.—Discharge Dec. 17 to Mar. 24, estimated because of ice, from discharge measurements, weather records and study of gage-height graph. Discharge June 21 to 23 estimated by comparison with record at Conklin. See "Diversions" in station description.

Monthly discharge of Chenango River near Chenango Forks, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 1,380 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	3,580	368	932	0.675	0.78
November	4,080	872	1,670	1.21	1.35
December	3,520	700	1,660	1.20	1.38
January	6,000	650	2,170	1.57	1.81
February	4,400	550	916	.664	.69
March	22,200	1,500	6,350	4.60	5.30
April	12,700	1,600	4,230	3.07	3.42
May	7,510	1,490	2,780	2.01	2.32
June	12,900	2,360	7,440	5.39	6.01
July	9,200	1,130	3,290	2.38	2.75
August	7,670	732	2,360	1.71	1.97
September	2,360	521	1,060	.768	.86
The year	22,200	368	2,660	1.93	26.64

CHEMUNG RIVER AT CHEMUNG, N. Y.

Location.—At highway bridge about midway between Chemung, Chemung County, N. Y., and Willawana, Pa., half a mile upstream from State line and about [illegible] miles above mouth.

Drainage area.—[illegible] square miles.

Records available.—September [illegible], 19[illegible], to September 30, 1917.

Gage.—Chain gage on the upstream side of the [illegible] span of the bridge; read by [illegible] [illegible].

Discharge measurements.—Made from the bridge or by wading.

Channel and control.—Sand and gravel; occasionally shifting.

Extremes of discharge.—Maximum stage recorded during year, [illegible] feet at 4.45 p. m. March [illegible] (discharge, [illegible] second-feet); minimum stage recorded [illegible] feet at [illegible] a. m. [illegible] [illegible] (discharge [illegible] second-feet); minimum discharge [illegible] second-feet February [illegible] (stage-discharge relation affected by ice).

19[illegible]-1917: Maximum stage recorded, [illegible] feet at [illegible] a. m. June [illegible], 19[illegible] (discharge about [illegible] second-feet); minimum stage recorded, [illegible] feet at [illegible] a. m. August 14, 19[illegible] (discharge about [illegible] second-feet).

Ice.—Stage-discharge relation affected by ice.

Regulation.—Power is developed above the station, the largest plant being at Elmira, N. Y.

Accuracy.—Stage-discharge relation practically permanent; affected by ice for a large portion of the period from December to March, inclusive. Rating curve well defined between [illegible] and [illegible] second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good, except for periods when the stage-discharge relation was affected by ice; fair for other periods.

Discharge measurements of Chemung River at Chemung, N. Y., during the year ending Sept. 30, 1917.

[Made by E. D. Burchard.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. [illegible]	a[illegible]	[illegible]	Feb. [illegible]	a[illegible]	[illegible]	Apr. 4	[illegible]	6,[illegible]
Jan. [illegible]	a[illegible]	[illegible]	Mar. [illegible]	a[illegible]	[illegible]	June [illegible]	[illegible].06	4,[illegible]

a Stage-discharge relation affected by ice.

aily discharge, in second-feet, of Chemung River at Chemung, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
	1,360	438	1,200	460	380	3,460	5,080	870	4,440	3,460	2,440	3,100
	790	451	1,050	340	700	2,440	7,850	915	3,460	11,000	1,730	5,080
	581	511	870	380	750	2,000	9,060	870	3,100	13,100	1,360	5,530
	477	504	790	380	800	1,480	7,010	790	2,440	6,240	1,150	6,000
	432	477	710	460	700	1,200	4,240	870	2,000	4,040	960	2,600
	383	438	623	1,500	600	870	4,860	4,650	2,290	3,100	870	2,140
	348	419	630	3,600	600	830	7,850	5,080	12,400	2,440	790	2,000
	332	413	595	2,000	500	915	7,280	4,440	18,000	2,440	790	1,860
	310	389	560	1,600	500	915	5,530	4,440	13,800	3,100	11,000	3,280
	332	389	560	1,400	440	790	4,040	4,040	8,750	3,460	5,300	2,140
	277	389	546	1,000	360	1,480	3,100	3,280	13,100	4,040	2,440	1,730
	277	451	518	800	340	23,400	3,100	2,440	8,440	4,650	1,600	1,480
	277	464	451	700	340	8,750	3,460	2,140	5,300	4,650	1,250	1,300
	277	458	420	950	280	5,080	2,930	1,860	3,840	3,280	7,560	1,150
	288	504	360	1,400	220	3,650	2,440	1,540	3,100	4,860	15,300	1,050
	343	567	320	1,200	220	2,760	2,140	1,300	2,760	3,460	9,380	960
	360	595	300	950	280	5,080	1,860	1,250	2,440	2,440	5,530	870
	321	560	280	700	280	5,300	1,730	1,250	2,000	2,290	3,460	790
	310	532	280	550	360	2,930	1,540	1,100	2,000	2,930	2,440	750
	389	511	300	550	600	2,000	1,420	1,100	3,100	3,280	1,860	790
	1,250	490	280	480	1,000	3,650	1,480	1,300	5,300	2,600	1,540	1,860
	1,730	504	320	340	1,000	3,460	1,480	1,250	3,100	2,600	1,300	1,250
	1,150	518	340	420	850	4,240	1,250	1,860	2,140	2,290	1,420	960
	870	532	380	550	800	7,850	1,150	2,290	11,000	2,000	6,000	790
	710	750	280	340	800	9,380	1,060	1,860	7,560	2,000	4,440	750
	630	960	420	550	1,200	7,280	1,000	1,600	4,240	1,600	2,290	670
	553	750	360	550	3,200	7,280	960	1,480	6,750	2,600	1,730	630
	532	750	300	440	7,010	11,700	870	1,730	5,300	2,290	1,360	616
	477	750	320	460	....	7,010	870	11,400	4,650	1,540	1,860	574
	451	760	320	300	....	5,530	830	11,000	5,300	13,800	3,460	574
	432	....	380	340	....	4,040	....	6,240	....	4,240	4,440	....

NOTE.—Discharge Dec. 14 to Feb. 27, estimated, because of ice, from discharge measurements, weather cords, and study of gage height graph.

Monthly discharge of Chemung River at Chemung, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 2,440 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
ctober	1,730	277	556	0.228	0.26
ovember	960	389	547	.224	.25
ecember	1,200	280	486	.199	.23
anuary	3,600	300	829	.340	.39
ebruary	7,000	220	896	.367	.38
arch	23,400	790	4,730	1.94	2.24
pril	9,060	830	3,250	1.33	1.48
ay	11,400	790	2,780	1.14	1.31
une	18,000	2,000	5,740	2.35	2.62
uly	13,800	1,540	4,060	1.66	1.91
ugust	15,300	790	3,460	1.42	1.64
eptember	6,000	574	1,780	.730	.81
The year	23,400	220	2,430	.996	13.52

CHEMUNG RIVER AT CHEMUNG, N. Y.

LOCATION.—At highway bridge about midway between Chemung, Chemung County, N. Y., and Willawana, Pa., half a mile upstream from State line and about 10 miles above mouth.

DRAINAGE AREA.—2,440 square miles.

RECORDS AVAILABLE.—September 11, 1903, to September 30, 1917.

GAGE.—Tape gage at the upstream side of the right span of the bridge; read by D. L. Orcutt.

DISCHARGE MEASUREMENTS.—Made from the bridge or by wading.

CHANNEL AND CONTROL.—Sand and gravel; occasionally shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.7 feet at 4.45 p. m. March 12 (discharge, 27,600 second-feet); minimum stage recorded 1.91 feet at 6 a. m. October 14 (discharge 260 second-feet); minimum discharge 220 second-feet February 15–16 (stage-discharge relation affected by ice).

1903–1917: Maximum stage recorded, 17.46 feet at 5 a. m. June 18, 1916 (discharge about 63,200 second-feet); minimum stage recorded, 1.47 feet at 7 a. m. August 14, 1911 (discharge about 49 second-feet).

ICE.—Stage-discharge relation affected by ice.

REGULATION.—Power is developed above the station, the largest plant being at Elmira, N. Y.

ACCURACY.—Stage-discharge relation probably permanent; affected by ice for a large portion of the period from December to March, inclusive. Rating curve well defined between 200 and 45,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good, except for periods when the stage-discharge relation was affected by ice; fair for other periods.

Discharge measurements of Chemung River at Chemung, N. Y., during the year ending Sept. 30, 1917.

[Made by E. D. Burchard.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 30	a 2.52	318	Feb. 11	a 2.88	851	Apr. 4	6.01	6,290
Jan. 20	a 3.53	640	Mar. 7	a 2.79	770	June 1	5.06	4,070

a Stage-discharge relat[illegible]d by ice.

Daily discharge, in second-feet, of Chemung River at Chemung, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,360	438	1,200	460	380	3,460	5,080	870	4,440	3,460	2,440	3,100
2	790	451	1,050	340	700	2,440	7,850	915	3,460	11,000	1,730	5,080
3	581	511	870	380	750	2,000	9,060	870	3,100	13,100	1,360	5,530
4	477	504	790	380	800	1,480	7,010	790	2,440	6,240	1,150	6,000
5	432	477	710	460	700	1,200	4,240	870	2,000	4,040	960	[illegible]
6	383	438	623	1,500	600	870	4,860	4,650	2,290	3,100	870	2,140
7	348	419	630	3,600	600	830	7,850	5,080	12,400	2,440	790	[illegible]
8	332	413	595	2,000	500	915	7,280	4,440	18,000	2,440	790	1,860
9	310	389	560	1,600	500	915	5,530	4,440	13,800	3,100	11,000	3,280
10	332	389	560	1,400	440	790	4,040	4,040	8,750	3,460	5,300	2,140
11	277	389	546	1,000	360	1,480	3,100	3,280	13,100	4,040	2,440	1,730
12	277	451	518	800	340	23,400	3,100	2,440	8,440	4,650	1,600	1,480
13	277	464	451	700	340	8,750	3,460	2,140	5,300	4,650	1,250	1,360
14	277	458	420	950	280	5,080	2,930	1,860	3,840	3,280	7,560	1,150
15	288	504	360	1,400	220	3,650	2,440	1,540	3,100	4,860	15,300	[illegible]
16	343	567	320	1,200	220	2,760	2,140	1,300	2,760	3,460	9,380	[illegible]
17	360	595	300	950	280	5,080	1,860	1,250	2,440	2,440	5,530	[illegible]
18	321	560	280	700	280	5,300	1,730	1,250	2,000	2,290	[illegible]	[illegible]
19	310	532	280	550	360	2,930	1,540	1,100	2,000	[illegible]	[illegible]	[illegible]
20	389	511	300	550	600	2,000	1,420	1,100	3,100	3,280	[illegible]	[illegible]
21	1,250	490	280	480	1,000	3,650	1,480	1,300	5,300	[illegible]	[illegible]	[illegible]
22	1,730	504	320	340	1,000	3,460	1,480	1,250	3,100	[illegible]	[illegible]	[illegible]
23	1,150	518	340	420	850	4,240	1,250	1,860	2,140	[illegible]	[illegible]	[illegible]
24	870	532	380	550	800	7,850	1,150	2,290	11,000	[illegible]	[illegible]	[illegible]
25	710	750	280	340	800	9,380	1,050	1,860	7,560	[illegible]	[illegible]	[illegible]
26	630	960	420	550	1,200	7,280	1,000	1,600	4,240	[illegible]	[illegible]	[illegible]
27	553	750	360	550	3,200	7,280	960	1,480	[illegible]	[illegible]	[illegible]	[illegible]
28	532	750	300	440	7,010	11,700	870	1,730	[illegible]	[illegible]	[illegible]	[illegible]
29	477	750	320	460	....	7,010	870	11,400	[illegible]	[illegible]	[illegible]	[illegible]
30	451	760	320	300	....	5,530	830	11,000	[illegible]	[illegible]	[illegible]	[illegible]
31	432	....	380	340	....	4,040	....	6,240	....	[illegible]	[illegible]	

NOTE.—Discharge Dec. 14 to Feb. 27, estimated, because of ice, from [illegible] records, and study of gage height graph.

Monthly discharge of Chemung River at Chemung, N. Y., for the [illegible] 1917.

[Drainage area, 2,440 square miles.]

Month.	Discharge in [illegible]					Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	[illegible]	Mean.	Per square mile.	
[illegible]ber	[illegible]	[illegible]	56	64.9	0.511	0.59
[illegible]mber	[illegible]	[illegible]	52	70.8	.557	.62
[illegible]mber	[illegible]	[illegible]	53	113	.890	1.03
[illegible]ary	[illegible]	[illegible]	88	169	1.33	1.53
[illegible]ruary	[illegible]	[illegible]	60	123	.969	1.01
[illegible]rch	[illegible]	[illegible]810	130	263	2.07	2.39
[illegible]pril	[illegible]	358	112	135	1.06	1.18
[illegible]ay	[illegible]	377	90	139	1.09	1.26
[illegible]ne	[illegible]	787	64	146	1.15	1.28
[illegible]uly	[illegible]	[illegible],200	60	176	1.39	1.60
[illegible]ugu[illegible]	[illegible]	296	50	75.9	.598	.69
[illegible]ep[illegible]	[illegible]	133	48	58.9	.464	.52
[illegible]	[illegible]	1,200	48	128	1.01	13.70

PATUXENT RIVER BASIN.

PATUXENT RIVER NEAR BURTONSVILLE, MD.

LOCATION.—At Columbia turnpike bridge, 1½ miles northeast of Burtonsville, Mon gomery County, and about 4 miles northwest of Laurel.

DRAINAGE AREA.—127 square miles.

RECORDS AVAILABLE.—July 21, 1911, to June 15, 1912 (records furnished by Unite States Engineer Office); July 21, 1913, to September 30, 1917.

GAGE.—Stevens water-stage recorder referred to a staff gage in three sections on le bank about 80 feet below highway bridge; prior to July 23, 1914, a vertical sta fastened to left side of bridge pier; datum of recorder is 1.29 feet below that gage on pier. Recorder inspected by Columbus Brashears and Arthur Beall.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Banks are lined with trees and brush and overflow stage of about 10 feet. Control is a flat gravel bar about 300 feet below bridg Current is swift under bridge, but sluggish below bridge to control. Discharg measurements indicate that control shifted during the flood of July 12–13, 1917.

EXTREMES OF DISCHARGE.—Maximum stage during year, 10.45 feet at 8 a. m. Jul 13 (discharge, 3,060 second-feet); minimum stage, from water-stage recorder, 1.9 feet September 23 (discharge, 47 second-feet). A stage of 1.70 feet occurred 3 a. m. February 3 and was probably caused by freezing at headwaters.

1911–1917: Maximum stage recorded, 14.6 feet about 9 a. m. January 12, 191 (discharge, from poorly defined rating curve, 5,100 second-feet); minimum stage 0.18 foot August 25, 1911 (discharge, 6 second-feet).

ICE.—Stage-discharge relation affected by ice during severe winters only.

ACCURACY.—Stage-discharge relation changed during the high water of July 12–13 affected by ice February 3–20. Rating curve well defined between 50 and 2,00 second-feet, used October 1 to July 12; curve well defined between 50 and 20 second-feet and fairly well defined above 200 second-feet used July 13 to Sep tember 30. Operation of water-stage recorder satisfactory throughout the year except for period December 20–24. Daily discharge ascertained by use of discharg integrator, by hourly method, and by use of mean daily gage heights obtained by inspecting recorder graph. Records excellent.

Discharge measurements of Pautuxent River near Burtonsville, Md., during the yea ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Dis-charge.
		Feet.	*Sec.-ft.*
Feb. 14	G. C. Stevens	a 2.36	64.5
June 2	Stevens and Hoyt	2.10	85.8

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Patuxent River near Burtonsville, Md., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	62	68	108	124	136	162	126	120	89	60	69	72
2	63	63	80	125	100	145	120	127	90	70	83	58
3	61	61	68	280	90	145	116	128	82	236	69	54
4	59	58	65	200	90	318	112	135	78	85	59	51
5	61	62	61	172	80	584	139	162	75	72	54	51
6	59	62	62	225	80	330	358	160	202	68	51	51
7	60	63	58	157	80	249	170	156	787	64	50	50
8	60	62	53	139	70	810	140	153	158	74	53	133
9	61	62	60	130	70	805	150	149	201	223	165	94
10	60	63	76	126	70	386	180	146	414	538	296	76
11	59	63	65	121	65	358	150	142	251	594	76	66
12	59	67	81	102	60	313	140	129	182	360	65	58
13	61	87	86	125	60	219	134	128	128	1,200	62	53
14	61	75	71	264	65	262	132	129	236	200	59	49
15	59	70	78	150	70	264	125	126	137	144	105	56
16	59	70	98	149	80	188	120	123	120	133	100	65
17	63	69	129	123	90	232	115	123	101	153	69	62
18	60	64	112	123	140	216	114	123	92	102	63	55
19	126	61	106	121	250	168	114	127	87	124	55	49
20	117	57	....	112	450	154	115	123	123	115	54	48
21	79	55	....	119	220	154	115	120	116	92	55	48
22	67	53	....	510	110	152	115	120	82	84	67	49
23	64	54	....	196	135	142	113	118	78	81	56	48
24	61	86	....	130	211	224	112	114	74	78	69	48
25	61	67	115	106	124	180	113	110	69	75	68	51
26	59	57	104	97	96	155	122	106	67	72	63	53
27	58	54	96	88	163	195	123	103	65	69	55	54
28	59	52	202	97	196	215	118	213	70	69	53	55
29	56	56	205	194	....	155	118	377	68	60	52	55
30	58	282	124	419	....	136	119	117	64	69	94	55
31	60	....	129	216	....	130	....	90	....	69	65	....

NOTE.—Mean discharge Dec. 20-24 estimated 200 second-feet. Discharge Feb. 3 to 20 estimated as in table, because of ice, from discharge measurement study of gage-height graph and weather records.

Monthly discharge of Patuxent River near Burtonsville, Md., for the year ending Sept. 30, 1917.

[Drainage area, 127 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	126	56	64.9	0.511	0.59
November	282	52	70.8	.557	.62
December	205	53	113	.890	1.03
January	510	88	169	1.33	1.53
February	450	60	123	.969	1.01
March	810	130	263	2.07	2.39
April	358	112	135	1.06	1.18
May	377	90	139	1.09	1.26
June	787	64	146	1.15	1.28
July	1,200	60	176	1.39	1.60
August	296	50	75.9	.598	.69
September	133	48	58.9	.464	.52
The year	1,200	48	128	1.01	13.70

POTOMAC RIVER BASIN.

POTOMAC RIVER AT POINT OF ROCKS, MD.

LOCATION.—At steel highway bridge at Point of Rocks, Frederick County, about one-third mile below Catoctin Creek and 6 miles above Monocacy River.

DRAINAGE AREA.—9,650 square miles.

RECORDS AVAILABLE.—February 17, 1895, to September 30, 1917.

GAGE.—Chain, attached to downstream side of left span of bridge; read by G. H. Hickman. Datum constant since September 2, 1902; prior to this date datum was 0.45 foot higher than at present. Sea-level elevation of gage datum, 200.54 feet.

DISCHARGE MEASUREMENTS.—Made from the bridge.

CHANNEL AND CONTROL.—Practically permanent. The control is a ledge a few hundred feet below the station, the ledge extending completely across the river except for one relatively unimportant channel.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 17.9 feet at 1.30 p. m., March 13 (discharge 121,000 second-feet); minimum stage recorded, 0.43 foot at 9 a. m., September 29 (discharge 643 second-feet).

1895–1916: Maximum stage recorded, 29 feet on March 2, 1902 (discharge 219,000 second-feet); minimum stage, 0.38 foot on September 10, 1914 (discharge 540 second-feet).

ICE.—Stage discharge relation seldom affected by ice.

DIVERSIONS.—The Chesapeake & Ohio Canal parallels the Potomac on the Maryland side. The average discharge of the canal is 75 to 100 second-feet. The discharge is not included in the following tables.

REGULATION.—Fluctuation at extremely low stages has been noted and is probably caused by the operation of power plants on the upper Potomac and tributaries.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice gorge about a mile below from February 13 to 21. Rating curve well defined except at extremely low water. Gage read to hundredths once daily; during high water read oftener. Daily discharge ascertained by applying daily gage heights to rating table. Records excellent except those for extremely low stages, which are fair.

The following discharge measurement was made by G. C. Stevens and B. L. Hopkins:

August 23, 1917: Gage height, 1.04 feet; discharge, 2,040 second-feet.

Daily discharge, in second-feet, of Potomac River at Point of Rocks, Md., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,800	1,840	2,250	9,070	10,000	14,600	10,000	4,500	16,300	2,800	1,990	1,290
2	3,090	2,120	1,860	9,070	10,000	14,900	9,530	4,010	14,600	2,970	1,890	2,090
3	3,540	1,760	1,610	8,180	9,530	15,200	8,180	3,860	11,000	2,970	2,070	2,200
4	2,800	1,660	1,460	7,750	8,620	15,200	7,330	4,500	10,500	3,120	2,020	1,890
5	2,380	1,480	3,860	8,180	8,180	24,200	6,130	6,130	13,500	2,940	2,660	1,660
6	1,990	1,290	3,540	9,070	9,530	26,800	10,000	6,520	8,620	2,550	2,300	1,290
7	1,840	1,190	3,240	11,000	8,180	22,300	16,300	6,920	17,400	2,450	2,170	1,190
8	1,560	1,060	2,940	11,000	6,920	27,500	19,800	6,520	19,800	2,450	1,940	1,030
9	1,410	966	2,800	12,000	6,520	36,300	24,800	5,750	20,400	2,250	5,420	1,540
10	1,290	1,640	2,120	11,500	5,750	90,500	22,300	5,750	9,070	4,880	4,500	1,260
11	1,100	1,510	1,910	11,000	5,750	53,200	19,800	5,380	13,500	5,200	4,200	1,540
12	1,190	1,760	1,610	5,750	5,750	80,500	16,300	4,840	14,600	4,980	3,510	1,190
13	1,340	1,940	1,910	5,380	5,400	118,000	15,200	5,750	8,620	6,640	3,090	1,350
14	1,680	1,990	1,960	5,380	5,200	100,000	14,600	6,130	6,520	5,940	2,860	1,290
15	1,840	1,890	1,890	6,520	5,100	65,600	14,100	6,130	6,130	4,430	3,510	1,680
16	1,660	1,610	1,640	6,520	5,000	64,700	13,500	5,750	5,020	6,640	3,700	1,810
17	1,790	1,680	1,680	4,330	4,900	57,200	9,530	5,380	4,670	3,980	3,700	2,020
18	1,840	1,790	1,360	3,860	5,100	56,400	9,070	5,380	4,500	3,730	2,940	1,790
19	2,250	1,680	1,260	3,700	5,300	55,600	8,620	5,380	3,090	3,090	2,720	1,660
20	2,660	1,540	2,250	3,240	5,500	40,700	7,750	5,020	2,800	4,430	2,380	1,310
21	2,250	1,190	2,800	4,170	5,700	32,800	6,520	4,840	3,860	3,790	2,330	1,220
22	2,250	1,060	2,380	4,670	5,750	22,900	6,130	4,500	3,090	3,180	2,220	1,050
23	2,380	966	3,390	14,600	5,380	20,400	6,130	4,330	2,800	2,800	2,200	1,140
24	2,660	1,340	2,940	29,400	5,020	16,300	5,380	4,330	2,800	2,940	2,040	1,360
25	3,540	1,220	2,800	21,700	9,070	14,100	5,020	2,520	2,520	3,180	1,940	1,440
26	3,390	1,710	2,380	15,700	12,000	23,600	5,020	2,380	2,120	2,660	1,940	944
27	2,940	1,580	2,380	9,070	15,200	21,100	6,130	3,090	2,250	6,320	2,040	769
28	2,380	1,540	2,660	7,750	19,200	19,800	5,750	3,700	2,120	5,750	2,170	834
29	2,120	1,390	10,000	7,330	....	14,100	5,750	6,520	1,990	4,430	1,990	643
30	1,990	1,990	16,300	7,750	....	14,100	5,750	13,000	1,990	4,200	1,840	900
31	1,940	....	9,530	9,530	....	12,000	....	14,600	....	2,940	1,030	....

NOTE.—Discharge Feb. 13-21 estimated because of ice gorge below station, by comparison with records on adjacent streams.

Monthly discharge of Potomac River at Point of Rocks, Md., for the year ending Sept. 30, 1917.

[Drainage area, 9,650 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	3,540	1,100	2,190	0.227	0.26
November	2,120	966	1,550	.161	.18
December	16,300	1,260	3,250	.337	.39
January	29,400	3,240	9,170	.950	1.10
February	19,200	4,900	7,630	.791	.82
March	118,000	12,000	38,400	3.98	4.59
April	24,800	5,020	10,700	1.11	1.24
May	14,600	2,380	5,590	.579	.67
June	20,400	1,990	7,870	.816	.91
July	6,640	2,250	3,890	.403	.46
August	5,420	1,030	2,620	.272	.31
September	2,200	643	1,380	.143	.16
The year	118,000	643	7,880	.817	11.09

MONOCACY RIVER NEAR FREDERICK, MD.

Location.—At Ceresville bridge on toll road leading from Frederick, Frederic County, to Mount Pleasant, about 3,000 feet below Tuscarora Creek (enterin from right), 2,000 feet above Israel Creek (entering from left), and 3 miles nortl east of Frederick.

Drainage area.—660 square miles.

Records available.—August 4, 1896, to September 30, 1917.

Gage.—Chain attached to downstream side of right span of bridge; read by Eugene I Derr.

Discharge measurements.—Made from the bridge or by wading.

Channel and control.—Bed composed of gravel and boulders; shifting during ver high floods. Control not well defined. Banks lined with trees and brush; subjec to overflow at high stages.

Extremes of discharge.—Maximum stage recorded during the year, 20.4 feet at 9.3 a. m. March 13 (discharge, 12,700 second-feet); minimum stage recorded, 4.2 feet October 10 (discharge, 122 second-feet).

1896–1917: Maximum stage recorded, 27.2 feet at 11 a. m. January 13, 191 (discharge determined from rating curve used for 1916, 19,000 second-feet) minimum stage, 3.54 feet several days in October, 1910 (discharge, 15 second feet).

Ice.—Stage-discharge relation affected by ice during severe winters only.

Accuracy.—Stage-discharge relation changed during high water in March, 1917; no affected by ice during the year. Rative curves well defined between 200 and 15,000 second-feet used before and after March 15. Discharge measurement made during high water of March, 1917, indicate that rating curves used prior to 1916 gave results about 20 per cent too large at high stages. Gage read to half tenths once daily; oftener during high water. Daily discharge ascertained by applying gage height to rating table. Records good.

Discharge measurements of Monocacy River near Frederick, Md., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 26	Stevens and Hoyt	4.68	230	Mar. 13	G. C. Stevens	10.90	4,220
Mar. 12	G. C. Stevens	19.22	[a] 11,800	13	.....do	10.00	3,400
12	.....do	18.21	[a] 10,500	Aug. 22	Stevens and Hopkins	4.52	210

[a] Surface velocities observed and coefficients between 0.80 and 0.88 used to reduce to mean velocity.

Daily discharge, in second-feet, of Monocacy River near Frederick, Md., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	286	158	750	465	850	1,230	784	415	1,260	204	218	294
2	171	158	485	445	850	850	736	396	1,640	201	204	262
3	171	158	335	638	900	800	644	396	736	294	218	247
4	158	146	302	1,170	950	705	600	396	434	262	191	232
5	146	146	212	1,610	950	750	578	454	343	232	178	204
6	134	158	171	3,060	900	1,230	7,550	556	882	204	165	204
7	146	171	171	1,480	850	1,290	2,630	474	4,230	204	1,090	204
8	134	146	158	1,350	485	1,540	2,480	454	1,570	204	178	690
9	122	134	198	1,000	445	6,740	2,340	434	882	1,260	4,900	1,840
10	122	134	184	750	405	5,500	1,910	415	690	1,260	2,840	600
11	122	134	198	615	405	5,660	1,380	396	784	690	1,090	396
12	146	134	335	405	335	9,750	1,140	360	2,480	1,140	535	294
13	134	134	445	425	302	4.480	982	360	1,030	667	378	262
14	134	134	370	2,320	270	3,440	882	326	736	556	343	232
15	134	134	302	1,610	270	3,060	784	310	622	326	982	1,090
16	134	122	302	1,420	270	2,340	736	294	600	556	310	2,410
17	122	134	286	2,320	255	3,220	667	278	578	644	232	784
18	134	134	270	1,890	240	2,990	600	262	434	1,380	278	600
19	134	134	270	1,420	240	1,510	578	262	396	2,480	262	360
20	7,010	134	240	950	335	1,380	644	262	360	1,140	232	294
21	950	134	226	950	405	1,320	600	247	343	535	232	278
22	682	134	240	3,290	525	1,640	644	247	326	454	204	262
23	465	134	1,610	2,610	750	1,380	556	262	310	434	204	247
24	352	198	1,110	950	1,290	1,710	514	262	294	396	1,710	232
25	226	171	728	850	1,420	1,570	514	262	294	2,840	1,140	232
26	226	184	705	705	1,420	1,140	535	247	294	1,320	278	232
27	226	146	1,230	425	1,420	1,510	514	232	262	556	232	218
28	198	146	2,610	405	1,350	2,050	474	396	232	396	204	204
29	184	146	1,890	405	....	1,140	454	2,050	232	326	204	204
30	171	525	900	1,420	....	982	434	832	218	294	326	204
31	171	....	615	1,350	....	832	....	784	....	262	360	....

Monthly discharge of Monocacy River near Frederick, Md., for the year ending Sept. 30, 1917.

[Drainage area, 660 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	7,010	122	440	0.667	0.77
November	525	122	158	.239	.27
December	2,610	158	576	.873	1.01
January	3,290	405	1,250	1.89	2.18
February	1,420	240	682	1.03	1.07
March	9,750	705	2,380	3.61	4.16
April	7,550	434	1,130	1.71	1.91
May	2,050	232	430	.652	.75
June	4,230	218	783	1.19	1.33
July	2,840	204	701	1.06	1.22
August	4,900	165	643	.974	1.12
September	2,410	204	460	.697	.78
The year	9,750	122	805	1.22	16.57

RAPPAHANNOCK RIVER BASIN.

RAPPAHANNOCK RIVER NEAR FREDERICKSBURG, VA.

LOCATION.—At rear of McWhirt farm, 1½ miles above dam of Spottsylvania Power Co. and 3½ miles above Fredericksburg, Spottsylvania County.

DRAINAGE AREA.—1,590 square miles.

RECORDS AVAILABLE.—September 19, 1907, to September 30, 1917.

GAGE.—Vertical staff on right bank; installed November 4, 1913, to replace chain gage destroyed October 31, 1913. Original gage was a vertical staff which was destroyed February 14, 1908, and replaced February 20, 1908, by a chain gage under the cable. All three gages at practically the same location and referred to same datum. Gage read by Charles Perry.

DISCHARGE MEASUREMENTS.—Made from cable at gage. At extremely low water measurements can be made by wading or from a bridge over the power canal below the dam.

CHANNEL AND CONTROL.—Bed composed of boulders; somewhat rough. One channel. Banks wooded; water overflows right bank at stage about 15 feet and left bank at about 12 feet. Current sluggish at extremely low water. Control is a rocky section a few hundred feet below the gage; practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage during the year, 8.5 feet March 5, determined from flood marks at gage (discharge, 23,100 second-feet); minimum stage recorded, 0.78 foot, October 10 and 13 (discharge, 212 second-feet).

1907–1917: Maximum stage recorded, 11.0 feet January 13, 1915, determined by leveling from flood marks (discharge, from extension of rating curve, 36,300 second-feet); minimum stage recorded, 0.30 foot at 3 p. m. August 21, 1914 (discharge, 72 second-feet).

ICE.—Ice forms near gage but seldom in sufficient quantity at control to affect stage-discharge relation.

ACCURACY.—Stage-discharge relation practically permanent; not affected by ice during year. Rating curve well defined except for extremely high and low stages. Gage read to hundredths twice daily; readings reported during the winter of 1916–17 not entirely reliable. Daily discharge ascertained by applying mean daily gage height to rating table. Records good except for winter months. Comparison with records for other stations indicates that the winter records of the Rappahannock are not subject to large errors.

The following discharge measurement was made by G. C. Stevens:

March 9, 1917: Gage height, 3.44 feet; discharge, 3,890 second-feet.

Daily discharge, in second-feet, of Rappahannock River near Fredericksburg, Va., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	455	494	1,350	1,560	1,770	2,740	1,420	1,700	1,160	550	645	1,700
2	418	550	1,070	1,220	1,480	4,610	1,420	1,480	2,240	486	569	729
3	418	518	598	1,770	1,220	7,070	1,350	1,420	1,700	518	860	588
4	336	448	470	1,480	1,100	16,800	1,280	1,480	1,420	1,350	1,700	1,560
5	288	478	510	1,620	1,220	19,600	1,350	2,000	1,280	860	1,100	860
6	288	455	448	2,570	975	8,010	20,600	1,770	1,220	626	708	518
7	288	448	432	1,280	1,220	3,700	5,910	1,420	1,220	518	569	1,350
8	288	448	432	1,160	805	2,920	3,490	1,480	1,100	550	542	1,220
9	270	470	502	975	860	3,920	3,100	1,480	1,160	626	550	1,420
10	212	448	440	918	860	2,740	3,700	1,480	2,920	455	4,140	805
11	288	362	534	918	750	2,920	2,570	1,220	3,100	9,760	1,700	588
12	245	470	805	729	645	3,490	2,400	1,160	1,920	3,700	918	486
13	212	518	918	502	550	4,140	2,240	1,100	1,620	1,220	656	455
14	288	470	805	588	645	5,910	2,920	1,040	1,420	918	550	750
15	288	510	1,040	2,570	750	5,100	2,240	1,040	5,910	656	550	455
16	260	470	860	2,240	805	4,140	1,920	975	3,490	510	542	486
17	260	432	470	2,740	918	4,850	1,770	860	1,480	1,480	534	860
18	317	462	395	1,770	750	3,920	1,620	698	1,350	1,620	534	687
19	542	448	395	1,160	1,100	3,290	1,560	616	1,040	860	687	470
20	2,570	329	432	860	1,100	3,100	1,700	588	918	687	550	448
21	1,040	362	918	860	1,420	2,920	1,620	534	805	750	470	440
22	805	329	5,100	918	1,160	2,920	1,620	550	1,220	708	462	382
23	676	375	8,680	1,480	1,350	2,740	1,350	666	918	645	1,350	645
24	598	432	2,400	1,280	1,220	2,570	1,280	698	750	708	2,570	478
25	578	455	1,920	1,620	2,000	2,740	1,220	636	645	1,480	1,420	342
26	494	550	1,350	1,100	1,700	2,080	1,350	626	750	5,100	1,160	305
27	494	510	1,100	860	1,350	2,240	1,280	698	510	3,490	729	329
28	418	440	1,280	1,350	1,700	2,920	1,480	1,040	805	2,240	550	336
29	440	550	3,290	1,920	....	2,080	2,000	2,570	740	1,420	462	395
30	418	626	1,620	3,100	....	1,770	2,000	2,920	676	975	860	329
31	323	....	1,620	2,440	....	1,620	....	1,560	....	750	1,840	....

Monthly discharge of Rappahannock River near Fredericksburg, Va., for the year ending Sept. 30, 1917.

[Drainage area, 1,590 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	2,570	212	478	0.301	0.35
November	626	329	462	.291	.32
December	8,680	395	1,360	.855	.99
January	3,100	502	1,470	.925	1.07
February	2,000	550	1,120	.704	.73
March	19,600	1,620	4,500	2.83	3.26
April	20,600	1,220	2,660	1.67	1.86
May	2,920	534	1,210	.761	.88
June	5,910	510	1,520	.956	1.07
July	9,760	455	1,490	.937	1.08
August	4,140	462	983	.618	.71
September	1,700	305	682	.429	.48
The year	20,600	212	1,500	.943	12.80

MISCELLANEOUS MEASUREMENTS.

The following table gives the results of measurements of flow of streams of the north Atlantic slope at points other than those at which gaging stations are maintained:

Miscellaneous discharge measurements in north Atlantic slope basins during the year ending Sept. 30, 1917.

Date.	Stream.	Tributary to or diverting from—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
Aug. 22	Cobbosseecontee stream	Kennebec River	Gardiner, Me.	134.74	255
30	....do	....do	....do	135.25	362
Sept. 4	....do	....do	....do	135.88	305
5	....do	....do	....do	136.00	296
10	....do	....do	....do	135.81	278
Aug. 25	Contoocook River	Merrimack River	Hillsboro, N. H.	[a] 19.04	245
Sept. 6	....do	....do	....do	[a] 19.02	266
9	....do	....do	....do	[a] 19.38	153
Aug. 24	Contoocook Canal	Contoocook River	....do	8.24	61
25	....do	....do	....do	7.14	6.6
25	....do	....do	....do	8.56	90
Sept. 5	....do	....do	....do	8.51	82
6	....do	....do	....do	7.14	6.2
8	....do	....do	....do	7.60	27.3
June 14	Diversion to Packard Pond.	East Branch of Tully River.	Near Athol, Mass.		13.0

[a] Distance to water surface from reference point on bridge.

INDEX.

STREAM-GAGING STATIONS

AND

PUBLICATIONS RELATING TO WATER RESOURCES

PART I. NORTH ATLANTIC SLOPE BASINS

STREAM-GAGING STATIONS AND PUBLICATIONS RELATING TO WATER RESOURCES.

PART I. NORTH ATLANTIC SLOPE BASINS.

INTRODUCTION.

Investigation of water resources by the United States Geological Survey has consisted in large part of measurements of the volume of flow of streams and studies of the conditions affecting that flow, but it has comprised also investigation of such closely allied subjects as irrigation, water storage, water powers, underground waters, and quality of waters. Most of the results of these investigations have been published in the series of water-supply papers, but some have appeared in the bulletins, professional papers, monographs, and annual reports.

The results of stream-flow measurements are now published annually in 12 parts, each part covering an area whose boundaries coincide with natural drainage features as indicated below.

PART I. North Atlantic slope basins.
II. South Atlantic slope and eastern Gulf of Mexico basins.
III. Ohio River basin.
IV. St. Lawrence River basin.
V. Upper Mississippi River and Hudson Bay basins.
VI. Missouri River basin.
VII. Lower Mississippi River basin.
VIII. Western Gulf of Mexico basins.
IX. Colorado River basin.
X. Great Basin.
XI. Pacific slope basins in California.
XII. North Pacific slope basins, in three volumes:
A, Pacific slope basins in Washington and upper Columbia River basin.
B, Snake River basin.
C, Lower Columbia River basin and Pacific slope basins in Oregon.

This appendix contains, in addition to the list of gaging stations and the annotated list of publications relating specifically to the section, a similar list of reports that are of general interest in many sections and cover a wide range of hydrologic subjects; also brief references to reports published by State and other organizations (p. XXIII).

HOW GOVERNMENT REPORTS MAY BE OBTAINED OR CONSULTED.

Water-supply papers and other publications of the United States Geological Survey containing data in regard to the water resources of the United States may be obtained or consulted as indicated below.

1. Copies may be obtained free of charge by applying to the Director of the Geological Survey, Washington, D. C. The edition printed for free distribution is, however, small and is soon exhausted.

2. Copies may be purchased at nominal cost from the Superintendent of Documents, Government Printing Office, Washington, D. C., who will on application furnish lists giving prices.

3. Sets of the reports may be consulted in the libraries of the principal cities in the United States.

4. Complete sets are available for consultation in the local offices of the water-resources branch of the Geological Survey as follows:

Boston, Mass., 2500 Customhouse.
Albany, N. Y., 704 Journal Building.
Atlanta, Ga., Post Office Building.
Madison, Wis., c/o Railroad Commission of Wisconsin.
Topeka, Kans., 25 Federal Building.
Austin, Tex., Capitol Building.
Helena, Mont., Montana National Bank Building.
Denver, Colo., 403 New Post Office Building.
Tucson, Ariz., University of Arizona.
Salt Lake City, Utah, 421 Federal Building.
Boise, Idaho, 615 Idaho Building.
Tacoma, Wash., 406 Federal Building.
Portland, Oreg., 606 Post Office Building.
San Francisco, Cal., 328 Customhouse.
Los Angeles, Cal., 619 Federal Building.
Honolulu, Hawaii, 14 Capitol Building.

A list of the Geological Survey's publications may be obtained by applying to the Director, United States Geological Survey, Washington, D. C.

STREAM-FLOW REPORTS.

Stream-flow records have been obtained at more than 4,240 points in the United States, and the data obtained have been published in the reports indicated in the following table:

Stream-flow data in reports of the United States Geological Survey.

[A—Annual Report; B—Bulletin; W—Water-Supply Paper.]

Report.	Character of data.	Year.
10th A, pt. 2	Descriptive information only	
11th A, pt. 2	Monthly discharge and descriptive information	1884 to Sept., 1890.
12th A, pt. 2	....do	1884 to June 30, 1891.
13th A, pt. 3	Mean discharge in second-feet	1884 to Dec. 31, 1892.
14th A, pt. 2	Monthly discharge (long-time records, 1871 to 1893)	1888 to Dec. 31, 1893.
B 131	Descriptions, measurements, gage heights, and ratings	1893 and 1894.
16th A, pt. 2	Descriptive information only	
B 140	Descriptions, measurements, gage heights, ratings, and monthly discharge (also many data covering earlier years).	1895.

Stream-flow data in reports of the United States Geological Survey—Continued.

Report.	Character of data.	Year.
W 11	Gage heights (also gage heights for earlier years)	1896.
18th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge (also similar data for some earlier years).	1895 and 1896.
W 15	Descriptions, measurements, and gage heights, eastern United States, eastern Mississippi River, and Missouri River above junction with Kansas.	1897.
W 16	Descriptions, measurements, and gage heights, western Mississippi River below junction of Missouri and Platte, and western United States.	1897.
19th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge (also some long-time records).	1897.
W 27	Measurements, ratings, and gage heights, eastern United States, eastern Mississippi River, and Missouri River.	1898.
W 28	Measurements, ratings, and gage heights, Arkansas River and western United States.	1898.
20th A, pt. 4	Monthly discharge (also for many earlier years)	1898.
W 35 to 39	Descriptions, measurements, gage heights, and ratings	1899.
21st A, pt. 4	Monthly discharge	1899.
W 47 to 52	Descriptions, measurements, gage heights, and ratings	1900.
22d A, pt. 4	Monthly discharge	1900.
W 65, 66	Descriptions, measurements, gage heights, and ratings	1901.
W 75	Monthly discharge	1901.
W 82 to 85	Complete data	1902.
W 97 to 100	....do	1903.
W 124 to 135	....do	1904.
W 165 to 178	....do	1905.
W 201 to 214	....do	1906.
W 241 to 252	....do	1907-8.
W 261 to 272	....do	1909.
W 281 to 292	....do	1910.
W 301 to 312	....do	1911.
W 321 to 332	....do	1912.
W 351 to 362	....do	1913.
W 381 to 394	....do	1914.
W 401 to 414	....do	1915.
W 431 to 444	....do	1916.
W 451 to 464	....do	1917.

NOTE—No data regarding stream flow are given in the 15th and 17th annual reports.

The records at most of the stations discussed in these reports extend over a series of years, and miscellaneous measurements at many points other than regular gaging stations have been made each year. An index of the reports containing records obtained prior to 1904 has been published in Water-Supply Paper 119.

The following table gives, by years and drainage basin, the numbers of papers on surface-water supply published from 1899 to 1917. The data for any particular station will be found in the reports covering the years during which the station was maintained. For example, data for 1902 to 1917 for any station in the area covered by Part III are published in Water-Supply Papers 83, 98, 128, 169, 205, 243, 263, 283, 303, 323, 353, 383, 403, 433, and 453 which contain records for the Ohio River basin for those years.

Numbers of water-supply papers containing results of stream measurements, 1899–1917.

Year.	I. North Atlantic slope basins (St. John River to York River).	II. South Atlantic and eastern Gulf of Mexico basins (James River to the Mississippi).	III. Ohio River basin.	IV. St. Lawrence River and Great Lakes basins.	V. Hudson Bay and upper Mississippi River basins.	VI. Missouri River basin.	VII. Lower Mississippi River basin.	VIII. Western Gulf of Mexico basins.	IX. Colorado River basin.	X. Great Basin.	XI. Pacific slope basins in California.	XII. North Pacific slope basins. Pacific slope basins in Washington and upper Columbia River.	XII. North Pacific slope basins. Snake River basin.	XII. North Pacific slope basins. Lower Columbia River and Pacific slope basins in Oregon.
1899 *a*	35	*b* 35, 36	36	36	36	*c* 36, 37	37	37	*d* 37, 38	38, *e* 39	38, *f* 39	38	38	38
1900 *g*	47, *h* 48	48	48, *i* 49	49	49	49, *j* 50	50	50	50	51	51	51	51	51
1901	65, 75	65, 75	65, 75	65, 75	*k* 65, 66, 75	66, 75	*k* 65, 66, 75	66, 75	66, 75	66, 75	66, 75	66, 75	66, 75	66, 75
1902	82	*b* 82, 83	83	*l* 82, 83	*k* 83, 85	84	*k* 83, 84	84	85	85	85	85	85	85
1903	97	*b* 97, 98	98	97	*k* 98, 99, *m* 100	99	*k* 98, 99	99	100	100	100	100	100	100
1904	*n* 124, *o* 125, *p* 126	*p* 126, 127	128	129	*k* 128, 130	130, *q* 131	*k* 128, 131	132	133	133, *r* 134	134	135	135	135
1905	*n* 165, *o* 166, *p* 167	*p* 167, 168	169	170	171	172	*k* 169, 173	174	175, *s* 177	176, *r* 177	177	178	178	*t* 177, 178
1906	*n* 201, *o* 202, *p* 203	*p* 203, 204	205	206	207	208	*k* 205, 209	210	211	212, *r* 213	213	214	214	214
1907–8	241	242	243	244	245	246	247	248	249	250, *r* 251	251	252	252	252
1909	261	262	263	264	265	266	267	268	269	270, *r* 271	271	272	272	272
1910	281	282	283	284	285	286	287	288	289	290	291	292	292	292
1911	301	302	303	304	305	306	307	308	309	310	311	312	312	312
1912	321	322	323	324	325	326	327	328	329	330	331	332A	332B	332C
1913	351	352	353	354	355	356	357	358	359	360	361	362A	362B	362C
1914	381	382	383	384	385	386	387	388	389	390	391	392	393	394
1915	401	402	403	404	405	406	407	408	409	410	411	412	413	414
1916	431	432	433	434	435	436	437	438	439	440	441	442	443	444
1917	451	452	453	454	455	456	457	458	459	460	461	462	463	464

a Rating tables and index to Water-Supply Papers 35–39 contained in Water Supply Paper 39. Tables of monthly discharge for 1899 in Twenty-first Annual Report, Part IV.
b James River only.
c Gallatin River.
d Green and Gunnison rivers and Grand River above junction with Gunnison.
e Mohave River only.
f Kings and Kern rivers and south Pacific slope basins.
g Rating tables and index to Water-Supply Papers 47–52 and data on precipitation, wells, and irrigation in California and Utah contained in Water-Supply Paper 52. Tables of monthly discharge for 1900 in Twenty-second Annual Report, Part IV.
h Wissahickon and Schuylkill rivers to James River.
i Scioto River.
j Loup and Platte rivers near Columbus, Nebr., and all tributaries below junction with Platte.
k Tributaries of Mississippi from east.
l Lake Ontario and tributaries to St. Lawrence River.
m Hudson Bay only.
n New England Rivers only.
o Hudson River to Delaware River, inclusive.
p Susquehanna River to Yadkin River, inclusive.
q Platte and Kansas Rivers.
r Great Basin in California except Truckee and Carson River basins.
s Below junction with Gila.
t Rogue, Umpqua, and Siletz Rivers only.

In these papers and in the following lists the stations are arranged in downstream order. The main stem of any river is determined by measuring or estimating its drainage area—that is, the headwater stream having the largest drainage area is considered the continuation of the main stream and local changes in name and lake surface are disregarded. All stations from the source to the mouth of the main stem of the river are presented first, and the tributaries in regular order from source to mouth follow, the streams in each tributary basin being listed before those of the next basin below.

In exception to this rule the records for Mississippi River are given in four parts, as indicated on page III, and the records for large lakes are taken up in order of streams around the rim of the lake.

PRINCIPAL STREAMS.

The principal streams flowing into the Atlantic Ocean between St. John River, Maine-New Brunswick, and York River, Virginia, are the St. Croix, Machias, Union, Penobscot, Kennebec, Androscoggin, Saco, Merrimack, Mystic, Blackstone, Connecticut, Hudson, Delaware, Susquehanna, Potomac, and Rappahannock. The streams drain wholly or in part the States of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Jersey, New Hampshire, New York, Pennsylvania, Rhode Island, Vermont, Virginia, and West Virginia.

GAGING STATIONS.[1]

NOTE.—Dash after date indicates that station was being maintained September 30, 1917. Period after a date indicates discontinuance.

ST. JOHN RIVER BASIN.

St. John River near Dickey, Maine, 1910–11.
St. John River at Fort Kent, Maine, 1905–1915.
St. John River at Van Buren, Maine, 1908–
- Allagash River near Allagash, Maine, 1910–11.
- St. Francis River at St. Francis, Maine, 1910–11.
- Fish River at Wallagrass, Maine, 1903–1908; 1911.
- Madawaska River at St. Rose du Degele, Quebec, 1910–11.
- Aroostook River at Fort Fairfield, Maine, 1903–1910.

ST. CROIX RIVER BASIN.

St. Croix River near Woodland (Spragues Falls), Maine, 1902–1911.
St. Croix River at Baring, Maine, 1914.
- West Branch of St. Croix River at Baileyville, Maine, 1910–1912.

MACHIAS RIVER BASIN.

Machias River at Whitney, Maine, 1903–

[1] St. John River to York River, inclusive.

UNION RIVER BASIN.

Union River, West Branch (head of Union River), at Amherst, Maine, 1909-
Union River, West Branch, near Mariaville, Maine, 1909.
Union River at Ellsworth, Maine, 1909.
East Branch of Union River near Waltham, Maine, 1909.
Webb Brook at Waltham, Maine, 1909.
Green Lake (head of Reeds Brook) at Green Lake, Maine, 1909–1912.
Reeds Brook [Green Lake Stream] at Lakewood, Maine, 1909–1913.
Branch Lake (head of Branch Lake Stream) near Ellsworth, Maine, 1909–1915.
Branch Lake Stream near Ellsworth, Maine, 1909–1914.

PENOBSCOT RIVER BASIN.

Penobscot River, West Branch (head of Penobscot River), at Millinocket, Maine, 1901–
Penobscot River, West Branch, near Medway, Maine, 1916–
Penobscot River at West Enfield, Maine, 1901–
Penobscot River at Sunkhaze rips, near Costigan, Maine, 1899–1900.
East Branch of Penobscot River at Grand Lake dam, Maine, 1912.
East Branch of Penobscot River at Grindstone, Maine, 1902–
Mattawamkeag River at Mattawamkeag, Maine, 1902–
Piscataquis River near Foxcroft, Maine, 1902–
Passadumkeag River at Lowell, Maine, 1915–
Cold Stream Pond (head of Cold Stream), Maine, 1900–1911 (record of opening and closing of pond).
Cold Stream at Enfield, Maine, 1904–1906.
Kenduskeag Stream near Bangor, Maine, 1908–
Orland River:
Phillips Lake outlet near East Holden, Maine, 1904–1908.

ST. GEORGE RIVER BASIN.

St. George River at Union, Maine, 1913–14.

KENNEBEC RIVER BASIN.

Moose River (head of Kennebec River) near Rockwood, Maine, 1902–1908; 1910–1912.
Moosehead Lake (on Kennebec River) at Greenville, Maine, 1903–1906 (stage only).
Moosehead Lake at east outlet, Maine (stage only), 1895–
Kennebec River at The Forks, Maine, 1901–
Kennebec River at Bingham, Maine, 1907–1910.
Kennebec River at North Anson, Maine, 1901–1907.
Kennebec River at Waterville, Maine, 1892–1916.
Kennebec River at Gardiner, Maine, 1785–1910 (record of opening and closing of navigation).
Roach River at Roach River, Maine, 1901–1908.
Dead River near The Forks, Maine, 1901–1907; 1910–
Carrabassett River at North Anson, Maine, 1901–1907.
Sandy River near Farmington, Maine, 1910–1915.
Sandy River near Madison, Maine, 1904–1908.
Sebasticook River at Pittsfield, Maine, 1908–
Messalonskee Stream at Waterville, Maine, 1903–1905.
Cobbosseecontee Lake (on Cobbosseecontee Stream), Maine, 1839–1911 (dates of opening and closing).
Cobbosseecontee Stream at Gardiner, Maine, 1890–1915.

ANDROSCOGGIN RIVER BASIN.

Rangeley Lake (head of Androscoggin River), Maine, 1879–1911 (dates of opening and closing).
Androscoggin River at Errol dam, N. H., 1905–
Androscoggin River at Berlin, N. H., 1913–
Androscoggin River at Gorham, N. H., 1903 (fragmentary).
Androscoggin River at Shelburne, N. H., 1903–1907; 1910.
Androscoggin River at Rumford Falls, Maine, 1892–1903; 1905–
Androscoggin River at Dixfield, Maine, 1902–1908.
    Magalloway River at Aziscohos dam, Maine, 1912–
    Auburn Lake, Maine, 1890–1911 (date of opening).
    Little Androscoggin River at Bisco Falls, near South Paris, Maine, 1913–

PRESUMPSCOT RIVER BASIN.

Presumpscot River at outlet of Sebago Lake, Maine, 1887–

SACO RIVER BASIN.

Saco River near Center Conway, N. H., 1903–1912.
Saco River at Cornish, Maine, 1916–
Saco River at West Buxton, Maine, 1907–
    Ossipee River at Cornish, Maine, 1916–

MERRIMACK RIVER BASIN.

Pemigewasset River (head of Merrimack River) at Plymouth, N. H., 1886–1913.
Merrimack River at Franklin Junction, N. H., 1903–
Merrimack River at Garvins Falls, N. H., 1904–1915.
Merrimack River at Lowell, Mass., 1848–1861; 1866–1916.
Merrimack River at Lawrence, Mass., 1880–
    Middle Branch of Pemigewasset River at North Woodstock, N. H., 1911–12.
    Lake Winnepesaukee at Lakeport, N. H., 1860–1911. (Stage only.)
    Contoocook River at West Hopkinton, N. H., 1903–1907.
    Suncook River at East Pembroke, N. H., 1904–5.
    Souhegan River at Merrimack, N. H., 1909–
    Nashua River:
        South Branch of Nashua River, Clinton, Mass., 1896–
    Concord River at Lowell, Mass., 1901–1916.
        Sudbury River at Framingham, Mass., 1875–
            Lake Cochituate at Cochituate, Mass., 1863–

MYSTIC RIVER BASIN.

Mystic Lake (on Mystic River) near Boston, Mass., 1878–1897.

CHARLES RIVER BASIN.

Charles River at Waltham, Mass., 1903–1909.

TAUNTON RIVER BASIN.

Matfield River (head of Taunton River) at Elmwood, Mass., 1909–10.
    Satucket River near Elmwood, Mass., 1909–10.

PROVIDENCE RIVER BASIN.

Providence River:
Seekonk River:
Tenmile River near Rumford, R. I., 1909.
Blackstone River at Woonsocket, R. I., 1904-5.
Blackstone River at Albion, R. I., 1914-
Blackstone River at Berkeley, R. I., 1901-2.
Branch River at Branch Village, R. I., 1909-10; 1912-13.
Woonasquatucket River at Olneyville, R. I., 1910

PAWTUXET RIVER BASIN.

Pawtuxet River at Harris, R. I., 1909.

PAWCATUCK RIVER BASIN.

Pawcatuck River:
Wood River at Hope Valley, R. I., 1909-10.

THAMES RIVER BASIN.

Thames River:
Quinebaug River:
Shetucket River at Willimantic, Conn., 1904-5.

CONNECTICUT RIVER BASIN.

Connecticut River at First Lake, near Pittsburg, N. H., 1917-
Connecticut River at Orford, N. H., 1900-
Connecticut River at Sunderland, Mass., 1904-
Connecticut River at Holyoke, Mass., 1880-1899.
Connecticut River at Hartford, Conn., 1896-1908.
Israel River above South Branch, near Jefferson Highlands, N. H., 1903-1906.
Israel River below South Branch, at Jefferson Highlands, N. H., 1903-1907.
Passumpsic River at Pierce's Mills, near St. Johnsbury, Vt., 1909-
Passumpsic River at St. Johnsbury Center, Vt., 1903.
Ammonoosuc River at Bretton Woods, N. H., 1903-1907.
Zealand River near Twin Mountains, N. H., 1903-1907.
Little River at Twin Mountain, N. H., 1904-5.
White River at Sharon, Vt., 1903-4; 1909-1913.
White River at West Hartford, Vt., 1915-
Ashuelot River at Winchester, N. H., 1903-4.
Ashuelot River at Hinsdale, N. H., 1907-1909; 1914-
Millers River at Wendell Depot, Mass., 1909-1913.
Millers River near Winchenden, Mass., 1916-
Millers River at Erving, Mass., 1914-
Sip Pond Brook near Winchenden, Mass., 1916-
Priest Brook near Winchenden, Mass., 1916-
Otter River near Gardner, Mass., 1916-17.
East Branch Tully River near Athol, Mass., 1916-
Moss Brook at Wendell Depot, Mass., 1909-10; 1916-
Deerfield River at Hoosac Tunnel, Mass., 1909-1913.
Deerfield River at Charlemont, Mass., 1913-
Deerfield River at Shelburne Falls, Mass., 1907-1913.
Deerfield River at Deerfield, Mass., 1904-5.
Ware River (head of Chicopee River) at Ware, Mass., 1904-1911.
Ware River at Gibbs Crossing, Mass., 1912-
Burnshirt River near Templeton, Mass., 1909.
Swift River at West Ware, Mass., 1910-
Quaboag River at West Warren, Mass., 1903-1907.
Quaboag River at West Brimfield, Mass., 1909-

Connecticut River tributaries—Continued.
Westfield River at Knightville, Mass., 1909–
Westfield River at Russell, Mass., 1904–5.
Westfield River near Westfield, Mass., 1914–
Middle Branch of Westfield River at Goss Heights, Mass., 1910–
West Branch of Westfield River at Chester, Mass., 1915.
Westfield Little River near Westfield, Mass., 1905–
Borden Brook near Westfield, Mass., 1910–
Farmington River near New Boston, Mass., 1913–
Salmon River at Leesville, Conn., 1905–6.

HOUSATONIC RIVER BASIN.

Housatonic River near Great Barrington, Mass., 1913–
Housatonic River at Falls Village, Conn., 1912–
Housatonic River at Gaylordsville, Conn., 1900–1914.
Tenmile River at Dover Plains, N. Y., 1901–1903.
Pomperaug River at Bennetts Bridge, Conn., 1913–1916.

MIANUS RIVER BASIN.

Mianus River at Bedford, N. Y., 1903.
Mianus River near Stamford, Conn., 1903.

BYRAM RIVER BASIN.

Byram River, West Branch (head of Byram River), near Port Chester, N. Y., 1903.
Byram River at Pemberwick, Conn., 1903.
East Branch of Byram River near Greenwich, Conn., 1903.
Middle Branch of Byram River near Riverville, Conn., 1903.

HUDSON RIVER BASIN.

Hudson River near Indian Lake, N. Y., 1916–
Hudson River at North Creek, N. Y., 1907–
Hudson River at Thurman, N. Y., 1907–
Hudson River at Corinth, N. Y., 1904–1912.
Hudson River at Spier Falls, N. Y., 1912–
Hudson River at Fort Edward, N. Y., 1899–1908.
Hudson River at Mechanicville, N. Y., 1890–
Cedar River near Indian Lake, N. Y., 1911–
Indian Lake reservoir near Indian Lake, N. Y., 1900–
Indian River near Indian Lake, N. Y., 1912–1914; 1915–
Schroon Lake (on Schroon River) at Pottersville, N. Y., 1908–1911.
Schroon River at Riverbank, N. Y., 1907–
Schroon River at Warrensburg, N. Y., 1895–1902.
Sacandaga River at Wells, N. Y., 1907–1911.
Sacandaga River near Hope, N. Y., 1911–
Sacandaga River at Northville, N. Y., 1907–1910.
Sacandaga River near Hadley, N. Y., 1907–1910.
Sacandaga River (at cable) at Hadley, N. Y., 1911–
Sacandaga River at Union Bag & Paper Co.'s mill at Hadley, N. Y., 1909–1911.
West Branch of Sacandaga River at Whitehouse, N. Y., 1910.
West Branch of Sacandaga River at Blackbridge, near Wells, N. Y., 1911–1916.
Batten Kill at Battenville, N. Y., 1908.
Fish Creek at Burgoyne, N. Y., 1905; 1908.
Hoosic River near Eagle Bridge, N. Y., 1910–

Hudson River tributaries—Continued.
- Hoosic River at Buskirk, N. Y., 1903–1908.
- Mohawk River at Ridge Mills, near Rome, N. Y., 1898–1900.
- Mohawk River at Utica, N. Y., 1901–1903.
- Mohawk River at Little Falls, N. Y., 1898–1909; 1912.
- Mohawk River at Rocky Rift dam, near Indian Castle, N. Y., 1901.
- Mohawk River at Tribes Hill, N. Y., 1912.
- Mohawk River at Schenectady, N. Y., 1899–1901.
- Mohawk River at Rexford Flats, N. Y., 1898–1901.
- Mohawk River at Vischer Ferry dam, N. Y., 1913–
- Mohawk River at Dunsbach Ferry, N. Y., 1898–1909.
  - Ninemile Creek at Stittville, N. Y., 1898–99.
  - Oriskany Creek at Coleman, N. Y., 1904–1906.
  - Oriskany Creek at Wood-road bridge, near Oriskany, N. Y., 1901–1904.
  - Oriskany Creek at State dam, near Oriskany, N. Y., 1898–1900.
  - Saquoit Creek at New York Mills, N. Y., 1898–1900.
  - Nail Creek at Utica, N. Y., 1904.
  - Reels Creek near Deerfield, N. Y., 1901–1904.
  - Reels Creek at Utica, N. Y., 1901–2.
    - Johnson Brook at Deerfield, N. Y., 1903–1905.
  - Starch Factory Creek at New Hartford, N. Y., 1903–1906.
    - Graefenberg Creek at New Hartford, N. Y., 1903–1906.
    - Sylvan Glen Creek at New Hartford, N. Y., 1903–1906.
  - West Canada Creek at Wilmurt,N. Y., 1912–13.
  - West Canada Creek at Twin Rock bridge, near Trenton Falls, N. Y., 1900–1909.
  - West Canada Creek at Poland, N. Y., 1913.
  - West Canada Creek at Middleville, N. Y., 1898–1901.
  - West Canada Creek at Kast Bridge, N. Y., 1905–1909; 1912–13.
  - East Canada Creek at Dolgeville, N. Y., 1898–1909; 1912.
  - Caroga Creek 3 miles above junction with Mohawk River, N. Y., 1898–99.
  - Cayadutta Creek at Johnstown, N. Y., 1899–1900.
  - Schoharie Creek at Prattsville, N. Y., 1902–1913.
  - Schoharie Creek at Schoharie Falls, above Mill Point, N. Y., 1900–1901.
  - Schoharie Creek at Mill Point, N. Y., 1900–1903.
  - Schoharie Creek at Fort Hunter, N. Y., 1898–1901.
  - Schoharie Creek at Erie Canal aqueduct, below Fort Hunter, N. Y., 1900.
    - Alplaus Kill near Charlton, N. Y., 1913–1916.
- Quacken Kill at Quacken Kill, N. Y., 1894.
- Normans Kill at Frenchs Mill, N. Y., 1891.
- Kinderhook Creek at Wilsons dam, near Garfield, N. Y., 1892–1894.
- Kinderhook Creek at East Nassau, N. Y., 1892–1894.
- Kinderhook Creek at Rossman, N. Y., 1906–1909; 1911–1914.
- Catskill Creek at South Cairo, N. Y., 1901–1907.
- Esopus Creek at Olivebridge, N. Y., 1903–4.
- Esopus Creek near Olivebridge, N. Y., 1906–1913.
- Esopus Creek at Kingston, N. Y., 1901–1909.
- Esopus Creek at Mount Marion, N. Y., 1907–1913.
- Roundout Creek at Rosendale, N. Y., 1901–1903; 1906–1913.
  - Diversion to Delaware and Hudson Canal at Rosendale, N. Y., 1901–1903, 1906.
  - Wallkill River at Newpaltz, N. Y., 1901–1903.
- Wappinger Creek at Wappinger Falls, N. Y., 1903–1905.
- Fishkill Creek at Glenham, N. Y., 1901–1903.
- Foundry Brook at Cold Spring, N. Y., 1902–3.
- Croton River at Croton dam, near Croton Lake, N. Y., 1870–1899.

PASSAIC RIVER BASIN.

Passaic River at Millington, N. J., 1903–1906.
Passaic River near Chathan, N. J., 1902–1911.
Passaic River at Two Bridges (Mountain View), N. J., 1901–1903.
    Rockaway River at Boonton, N. J., 1903–4.
    Pompton River at Pompton Plains, N. J., 1903–4.
    Pompton River at Two Bridges (Mountain View), N. J., 1901–1903.
        Ramapo River near Mahwah, N. J., 1903–1906; 1908.
        Wanaque River at Wanaque, N. J., 1903–1905.

RARITAN RIVER BASIN.

Raritan River, South Branch (head of Raritan River), at Stanton, N. J., 1903–1906.
Raritan River at Finderne, N. J., 1903–1907.
Raritan River at Boundbrook, N. J., 1903–1909.
    North Branch of Raritan River at Pluckemin, N. J., 1903–1906.
    Millstone River at Millstone, N. J., 1903–4.

DELAWARE RIVER BASIN.

Delaware River, East Branch (head of Delaware River) at Fish Eddy, N. Y., 1912–
Delaware River, East Branch, at Hancock, N. Y., 1902-1912.
Delaware River at Port Jervis, N. Y., 1904–
Delaware River at Riegelsville, N. J., 1906–
Delaware River at Lambertville, N. J., 1897–1908.
    Beaver Kill at Cooks Falls, N. Y., 1913–
    West Branch of Delaware River at Hale Eddy, N. Y., 1912–
    West Branch of Delaware River at Hancock, N. Y., 1902–1912.
    Mongaup River near Rio, N. Y., 1909–1913.
    Neversink River at Godeffroy, N. Y., 1903; 1909–10; 1911–1914.
    Neversink River at Port Jervis, N. Y., 1902–3.
    Paulins Kill at Columbia, N. J., 1908–9.
    Lehigh River at South Bethlehem, Pa., 1902–1905; 1909–1913.
    Lehigh River at Easton, Pa., 1909.
    Musconetcong River at Asbury, N. J., 1903.
    Musconetcong River near Bloomsbury, N. J., 1903–1907.
    Tohickon Creek at Point Pleasant, Pa., 1883–1889; 1901–1913.
    Neshaminy Creek below Forks, Pa., 1884–1913.
    Schuylkill River near Philadelphia, Pa., 1898–1912.
        Perkiomen Creek near Frederick, Pa., 1884–1913.
        Wissahickon Creek near Philadelphia, Pa., 1897–1902; 1905–6.

SUSQUEHANNA RIVER BASIN.

Susquehanna River at Colliersville, N. Y., 1907–8.
Susquehanna River at Conklin, N. Y., 1912–
Susquehanna River at Binghamton, N. Y., 1901–1912.
Susquehanna River at Wysox, Pa., 1908–9.
Susquehanna River at Wilkes-Barre, Pa., 1899–1913.
Susquehanna River at Danville, Pa., 1899–1913.
Susquehanna River at Harrisburg, Pa., 1891–1913.
Susquehanna River at McCall Ferry, Pa., 1902–1909.
    Chenango River at South Oxford, N. Y., 1903.
    Chenango River near Greene, N. Y., 1908.
    Chenango River near Chenango Forks, N. Y., 1912–

Susquehanna River tributaries—Continued.
Chenango River at Binghamton, N. Y., 1901–1912.
Eaton Brook, Madison County, N. Y., 1835.
Madison Brook, Madison County, N. Y., 1835.
Tioughnioga River at Chenango Forks, N. Y., 1903.
Cayuta Creek at Waverly, N. Y., 1898–1902. (Data in Water-Supply Paper 109 only.)
Chemung River at Chemung, N. Y., 1903– (Data for period prior to 1905 published in Water-Supply Paper 109.)
West Branch of Susquehanna River at Williamsport, Pa., 1895–1913.
West Branch of Susquehanna River at Allenwood, Pa., 1899–1902.
Juniata River at Newport, Pa., 1899–1913.
Broad Creek at Mill Green, Md., 1905–1909.
Octoraro Creek at Rowlandsville, Md., 1896–1899.
Deer Creek near Churchville, Md., 1905–1909.

GUNPOWDER RIVER BASIN.

Gunpowder Falls at Glencoe, Md., 1905–1909.
Little Gunpowder Falls near Belair, Md., 1905–1909.

PATAPSCO RIVER BASIN.

Patapsco River at Woodstock, Md., 1896–1909.

PATUXENT RIVER BASIN.

Patuxent River near Burtonsville, Md., 1911–12; 1913–
Patuxent River at Laurel, Md., 1896–1898.

POTOMAC RIVER BASIN.

Potomac River North Branch (head of Potomac River), at Piedmont, W. Va., 1899–1906.
Potomac River, North Branch, at Cumberland, Md., 1894–1897.
Potomac River at Great Cacapon, W. Va., 1895.
Potomac River at Point of Rocks, Md., 1895–
Potomac River at Great Falls, Md., 1886–1891.
Potomac River at Chain Bridge, near Washington, D. C., 1892–1895.
Savage River at Bloomington, Md., 1905–6.
Georges Creek at Westernport, Md., 1905–6.
Wills Creek near Cumberland, Md., 1905–6.
South Branch of Potomac River near Springfield, W. Va., 1894–1896; 1899–1906.
Opequan Creek near Martinsburg, W. Va., 1905–6.
Tuscarora Creek at Martinsburg, W. Va., 1905.
Antietam Creek near Sharpsburg, Md., 1897–1905.
North River (head of South Fork of Shenandoah River, which is continuation of main stream) at Port Republic, Va., 1895–1899.
South Fork of Shenandoah River near Front Royal, Va., 1899–1906.
Shenandoah River at Millville, W. Va., 1895–1909.
Cooks Creek at Mount Crawford, Va., 1905–6.
Middle River:
Lewis Creek near Staunton, Va., 1905–6.
South River at Basic City, Va., 1905–6.
South River at Port Republic, Va., 1895–1899.
Elk Run at Elkton, Va., 1905–6.
Hawksbill Creek near Luray, Va., 1905–6.
North Fork of Shenandoah River near Riverton, Va., 1899–1906.

Potomac River tributaries—Continued.
Passage Creek at Buckton, Va., 1905–6.
Monocacy River near Frederick, Md., 1896–
Goose Creek near Leesburg, Va., 1909–1912.
Rock Creek at Zoological Park, D. C., 1897–1900.
Rock Creek at Lyons Mill, D. C., 1892–1894.
Occoquan Creek near Occoquan, Va., 1913–1916.

RAPPAHANNOCK RIVER BASIN.

Rappahannock River near Fredericksburg, Va., 1907–

REPORTS ON WATER RESOURCES OF NORTH ATLANTIC COAST.[1]

PUBLICATIONS OF UNITED STATES GEOLOGICAL SURVEY

WATER-SUPPLY PAPERS.

Water-supply papers are distributed free by the Geological Survey as long as its stock lasts. An asterisk (*) indicates that this stock has been exhausted. Many of the papers marked in this way may, however, be purchased (at price noted) from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C. Omission of the price indicates that the report is not obtainable from Government sources. Water-supply papers are of octavo size.

*24. Water resources of the State of New York, Part I, by G. W. Rafter. 1899. 99 pp., 13 pls. 15c.

Describes the principal rivers of New York and their more important tributaries, and gives data on temperature precipitation evaporation and stream flow.

*25. Water resources of the State of New York, Part II, by G. W. Rafter. 1899. 100 pp., 12 pls. 15c.

Contains discussion of water-storage projects on Genesee and Hudson rivers, power development at Niagara Falls, descriptions and early history of State canals, and a chapter on the use and value of the water power of the streams and canals; also brief discussion of the water yields of sand areas of Long Island.

*44. Profiles of rivers in the United States, by Henry Gannett. 1901. 100 pp., 11 pls. 15c.

Gives elevations and distances along rivers of the United States also brief descriptions of many of the streams, including St. Croix, Penobscot, Kennebec, Androscoggin, Saco, Merrimack, Connecticut, Housatonic, Hudson, Mohawk, Delaware, Lehigh, Schuylkill, Susquehanna, Juniata, Potomac, and James rivers.

*57. Preliminary list of deep borings in the United States, Part I (Alabama-Montana), by N. H. Darton. 1902. 60 pp. (See No. 149.) 5c.

*61. Preliminary list of deep borings in the United States, Part II (Nebraska-Wyoming), by N. H. Darton. 1902. 67 pp. 5c.

Nos. 57 and 61 contain information as to depth, diameter, yield, and head of water in borings more than 400 feet deep; under head "Remarks" give information concerning temperature, quality of water, purposes of boring, etc. The lists are arranged by States, and the States are arranged alphabetically. Revised edition published in 1905 as Water-Supply Paper 149 (q. v.).

*69. Water powers of the State of Maine, by H. A. Pressey. 1902. 124 pp., 14 pls. 20c.

Discusses briefly the geology and forests of Maine and in somewhat greater detail the drainage areas, lake storage, and water powers of the St. Croix, Penobscot, Kennebec, Androscoggin, Presumpscot, Saco, and St. John rivers, and the minor coastal streams; mentions also developed tidal powers.

72. Sewage pollution in the metropolitan area near New York City and its effect on inland water resources, by M. O. Leighton. 1902. 75 pp., 8 pls. 10c.

Defines "normal" and "polluted" waters and discusses the water of Raritan, Passaic, and Hudson rivers and their tributaries and the damage resulting from pollution.

76. Observations on the flow of rivers in the vicinity of New York City, by H. A. Pressey. 1903. 108 pp., 13 pls. 15c.

Describes methods of measuring stream flow in open channels and under ice, and the quality of the river water as determined by tests of turbidity, color, alkalinity, and permanent hardness. The streams considered are Catskill, Esopus, Rondout, and Fishkill creeks, and Wallkill, Tenmile, and Housatonic rivers.

79. Normal and polluted waters in northeastern United States, by M. O. Leighton. 1903. 192 pp. 10c.

Defines essential qualities of water for various uses, the impurities in rain, surface, and underground waters, the meaning and importance of sanitary analyses, and the principal sources of pollution; chiefly "a review of the more readily available records" of examination of water supplies derived from streams in the Merrimack, Connecticut, Housatonic, Delaware, and Ohio River basins; contains many analyses.

[1] For stream-measurement reports see tables on pages IV-V and VI.

88. The Passaic flood of 1902, by G. B. Hollister and M. O. Leighton. 1903. 56 pp., 15 pls. 15c.

Describes the topography of the area drained by the Passaic and its principal tributaries; discusses flood flow and losses caused by the floods, and makes comparison with previous floods; suggests construction of dam at Mountain View to control flood flow. See also No. 92.

92. The Passaic flood of 1903, by M. O. Leighton. 1904. 48 pp., 7 pls. 5c.

Discusses flood damages and preventive measures. See No. 88.

102. Contributions to the hydrology of eastern United States, 1903; M. L. Fuller, geologist in charge. 1904. 522 pp. 30c.

Contains brief reports on the wells and springs of the New England States and New York. The reports comprise tabulated well records giving information as to location, owner, depth, yield, head, etc., supplemented by notes as to elevation above sea, material penetrated, temperature, use, and quality; many miscellaneous analyses.

*103. A review of the laws forbidding pollution of inland waters in the United States, by E. B. Goodell. 1904. 120 pp. Superseded by 152.

Cites statutory restrictions of water pollution.

106. Water resources of the Philadelphia district, by Florence Bascom. 1904. 75 pp., 4 pls. 5c.

Describes the physiography, stratigraphic geology, rainfall, streams, ponds, springs, deep and artesian wells, and public water supplies of the area mapped on the Germantown, Norristown, Philadelphia, and Chester atlas sheets of the United States Geological Survey; compares quality of Delaware and Schuylkill River waters.

108. Quality of water in the Susquehanna River drainage basin, by M. O. Leighton, with an introductory chapter on physiographic features, by G. B. Hollister. 1904. 76 pp., 4 pls. 15c.

109. Hydrography of the Susquehanna River drainage basin, by J. C. Hoyt and R. H. Anderson. 1905. 215 pp., 29 pls. 25c.

The scope of No. 108 is sufficiently indicated by its title. No. 109 describes the physical features of the area drained by the Susquehanna and its tributaries, contains the results of measurements of flow at the gaging stations, and discusses precipitation, floods, low water, and water power.

110. Contributions to the hydrology of eastern United States, 1904; M. L. Fuller, geologist in charge. 1905. 211 pp., 5 pls. 10c.

Contains brief reports on water resources, surface and underground, of districts in the North Atlantic slope drainage basins, as shown by the following list:

Drilled wells of the Triassic area of the Connecticut Valley, by W. H. C. Pynchon.

Triassic rocks of the Connecticut Valley as a source of water supply, by M. L. Fuller. Scope indicated by title.

Water resources of the Taconic quadrangle, New York, Massachusetts, and Vermont, by F. B. Taylor. Discusses rainfall, drainage, water powers, lakes and ponds, underground waters, and mineral springs; also quality of spring water as indicated by chemical and sanitary analyses of Sand Spring, near Williamstown.

Water resources of the Watkins Glen quadrangle, New York, by Ralph S. Tarr. Discusses the use of the surface and underground waters for municipal supplies and their quality as indicated by examination of Sixmile and Fall creeks, and sanitary analyses of well water at Ithaca.

Water resources of the central and southwestern highlands of New Jersey, by Laurence La Forge. Treats of population, industries, climate, and soils, lakes, ponds, swamps and rivers, mineral springs (with analyses), water power, and the Morris Canal; present and prospective sources and quality of municipal supplies.

Water resources of the Chambersburg and Mercersburg quadrangles, Pennsylvania, by George W. Stose. Describes streams and springs.

Water resources of the Curwensville, Patton, Ebensburg, and Barnesboro quardangles, Pennsylvania, by F. G. Clapp. Treats briefly of surface and underground waters and their use for municipal supplies; gives analyses of waters at Cresson Springs.

Water resources of the Accident and Grantsville quadrangles, Maryland, by G. C. Martin.

Water resources of the Frostburg and Flintstone quadrangles, Maryland and West Virginia, by G. C Martin.

*114. Underground waters of eastern United States; M. L. Fuller, geologist in charge. 1905. 285 pp., 18 pls. 25c.

Contains brief reports on water supplies of the North Atlantic States as follows:
Maine, by W. S. Bayley.
New Hampshire, by M. L. Fuller.
Vermont, by G. H. Perkins.
Massachusetts and Rhode Island, by W. O. Crosby.
Connecticut, by H. E. Gregory.
New York, by F. B. Weeks.
New Jersey, by G. N. Knapp.
Pennsylvania, by M. L. Fuller.
Delaware, by N. H. Darton.
Maryland, by N. H. Darton and M. L. Fuller.
District of Columbia, by N. H. Darton and M. L. Fuller.
Virginia, by N. H. Darton and M. L. Fuller.

Each of these reports discusses the resources of the public and private water supplies and related subjects, and gives list of pertinent publications; mineral springs are listed and sales of mineral water are reported.

*122. Relation of the law to underground waters, by D. W. Johnson. 1905. 55 pp. 5c.

Cites legislative acts relating to ground waters in New Jersey.

140. Field measurements of the rate of movement of underground waters, by C. S. Slichter. 1905. 122 pp., 15 pls. 15c.

Contains chapter on measurement of rate of underflow on Long Island, N. Y.

144. The normal distribution of chlorine in the natural waters of New York and New England, by D. D. Jackson. 1905. 32 pp., 5 pls. 10c.

Discusses common salt in coast and inland waters, salt as an index to pollution of streams and wells, the solutions and methods used in chlorine determinations, and the use of the normas chlorine map; gives charts and tables for chlorine in the New England States and New York.

145. Contributions to the hydrology of eastern United States, 1905; M. L. Fuller, geologist in charge. 1905. 220 pp., 6 pls. 10c.

Contains several brief reports relating chiefly to areas in the North Atlantic coast drainage basins, as follows:

Water resources of the Portsmouth-York region, New Hampshire and Maine, by George Otis Smith. Gives results of investigations made for the War Department to determine water supplies available for forts at mouth of harbor.

Water supply from glacial gravels near Augusta, Maine, by George Otis Smith. Describes the Silver Lake system of ponds near Augusta and the series of springs at the head of Spring Brook.

Water resources of the Pawpaw and Hancock quadrangles, West Virginia, Maryland, and Pennsylvania, by George W. Stose and George C. Martin. Describes rocks, springs, and streams in the area at the northernmost bend of the Potomac; discusses history of development, character of water (with analysis), flow, and origin of Berkeley Springs.

Water of a gravel-filled valley near Tully, N. Y., by George B. Hollister. Describes character of the sands and gravels, the volume of the springs issuing from them, deposits of tufa, the waters of the lakes, and the composition of the spring and lake waters; analyses.

147. Destructive floods in United States in 1904, by E. C. Murphy and others. 206 pp., 18 pls. 15c.

Describes floods on Susquehanna and Mohawk rivers and near Johnstown, Pa.

*149. Preliminary list of deep borings in the United States, second edition, with additions, by N. H. Darton. 1905. 175 pp. 10c.

Gives by States (and within the States by counties), location, depth, diameter, yield, height of water, and other available information, concerning wells 400 feet or more in depth; includes all wells listed in Water-Supply Papers 57 and 61; mentions also principal publications relating to deep borings.

*152. A review of the laws forbidding pollution of inland waters in the United States (second edition), by E. B. Goodell. 1905. 149 pp. 10c.

Cites statutory restrictions of water pollution.

*155. Fluctuations of the water level in wells, with special reference to Long Island, New York, by A. C. Veatch. 1906. 83 pp., 9 pls. 25c.

Includes general discussion of fluctuation due to rainfall evaporation, barometric changes, temperature changes, changes in rivers, changes in lake level, tidal changes, effects of settlement, irrigation, dams, underground-water developments, and to indeterminate causes.

*162. Destructive floods in the United States in 1905, with a discussion of flood discharge and frequency and an index to flood literature, by E. C. Murphy and others. 1906. 105 pp., 4 pls. 15c.

Contains accounts of floods in North Atlantic slope drainage basins as follows: Flood on Poquonnock River, Connecticut, by T. W. Norcross; flood on the Unadilla and Chenango rivers, New York, by R. E. Horton and C. C. Covert; also estimates of flood discharge and frequency on Kennebec, Androscoggin, Merrimack, Connecticut, Hudson, Passaic, Raritan, Delaware, Susquehanna, and Potomac rivers; gives index to literature on floods on American streams.

*185. Investigations on the purification of Boston sewage, with a history of the sewage-disposal problem, by C.-E. A. Winslow and E. B. Phelps. 1906. 163 pp. 25c.

Discusses composition, disposal, purification, and treatment of sewage and sewage-disposal practice in England, Germany, and the United States; describes character of crude sewage at Boston, removal of suspended matter, treatment in septic tanks, and purification in intermittent sand filtration and coarse material; gives bibliography.

*192. The Potomac River basin (Geographic history; Rainfall and stream flow; Pollution, typhoid fever, and character of water; Relation of soils and forest cover to quality and quantity of surface water; Effect of industrial wastes on fishes), by H. N. Parker, Bailey Willis, R. H. Bolster, W. W. Ashe, and M. C. Marsh. 1907. 364 pp., 10 pls. 60c.

Scope indicated by title.

*198. Water resources of the Kennebec River basin, Maine, by H. K. Barrows, with a section on the quality of Kennebec River water, by G. C. Whipple. 1907. 235 pp., 7 pls. 30c.

Describes physical characteristics and geology of the basin, the flow of the streams, evaporation, floods, developed and undeveloped water powers, water storage, log driving, and lumbering; under quality of water discusses effect of tides, pollution, and the epidemic of typhoid fever in 1902–3; contains gazetteer of rivers, lakes, and ponds.

*223. Underground waters of southern Maine, by F. G. Clapp, with records of deep-wells, by W. S. Bayley. 1909. 268 pp., 24 pls. 55c.

Describes physiography, rivers, water-bearing rocks, amount, source, and temperature of the ground waters, recovery of waters by springs, collecting galleries and tunnels, and wells; discusses well-drilling methods, municipal water supplies, and the chemical composition of the ground waters; gives details for each county.

232. Underground-water resources of Connecticut, by H. E. Gregory, with a study of the occurrence of water in crystalline rocks, by E. E. Ellis. 1909. 200 pp., 5 pls. 20c.

Describes physiographic features, drainage, forests, climate, population and industries, and rocks; circulation, amount, temperature, and contamination of ground water; discusses the ground waters of the crystalline rocks, the Triassic sandstones and traps, and the glacial drift; the quality of the ground waters (with analyses); well construction; temperature, volume, character, uses, and production of spring waters.

236. The quality of surface waters in the United States, Part I, Analyses of waters east of the one hundredth meridian, by R. B. Dole. 1909. 123 pp. 10c.

Describes collection of samples, method of examination, preparation of solutions, accuracy of estimates, and expression of analytical results; gives results of analyses of waters of Androscoggin, Hudson, Raritan, Delaware, Susquehanna, Lehigh, Potomac, and Shenandoah rivers.

*258. Underground-water papers, 1910, by M. L. Fuller, F. G. Clapp, G. C. Matson, Samuel Sanford, and H. C. Wolff. 1911. 123 pp., 2 pls. 15c.

Contains four brief reports pertaining especially to districts in the North Atlantic coast drainage areas:

Occurrence and composition of well waters in the slates of Maine, by F. G. Clapp. Analyses.
Occurrence and composition of well waters in the granites of New England, by F. G. Clapp Discusses proportion of successful wells and water supply and depth. Analyses.
Composition of mineral springs in Maine, by F. G. Clapp.
Saline artesian waters of the Atlantic Coastal Plain, by Samuel Sanford.
Underground waters near Manassas, Va., by F. G. Clapp.

279. Water resources of the Penobscot River basin, Maine, by H. K. Barrows and C. C. Babb. 1912. 285 pp., 19 pls. 65c.

Describes the topography, drainage, geology, forests, population, industries, transportation lines, and precipitation in the basin; gives results of investigations of stream flow at gaging stations; discusses relation of run-off to precipitation, evaporation, floods, low water, developed, and undeveloped water powers, storage, log driving, and lumbering; contains gazetteer of rivers, lakes, and ponds.

374. Ground water in the Hartford, Stamford, Salisbury, Willimantic, and Saybrook areas, Connecticut, by H. E. Gregory and A. J. Ellis. 1916. 150 pp., 13 pls. 30c.

Describes occurrence of ground water, methods of developing, and requirements for municipal use. Gives, by towns, a description of the surface and ground water and of the public water supply, and records of wells and springs.

*397. Ground water in the Waterbury area, Connecticut, by A. J. Ellis, under direction of H. E. Gregory. 1916. 73 pp., 4 pls. 15c.

Describes the geology of the area, the occurrence of ground water, its use for private and municipal supply, and methods of developing. Discusses under towns the population and industries, topography, water-bearing formations, surface and ground water, and public supplies, and gives records of wells and springs.

415. Surface waters of Massachusetts, by C. H. Pierce and H. J. Dean. 1916. 433 pp., 12 pls. 45c.

A compilation of available stream-flow data, including the classic records collected on the Merrimack at Lowell and Lawrence, on the Connecticut at Holyoke, and on the Cochituate at Sudbury by the Metropolitan Water and Sewerage Board, as well as records covering shorter periods; prepared in cooperation with the Commonwealth of Massachusetts. Contains a gazetteer of streams, lakes, and ponds.

424. Surface waters of Vermont, by C. H. Pierce. 1917. 218 pp., 14 pls.

A compilation of available stream-flow data; prepared in cooperation with the Commonwealth of Vermont. Contains a gazetteer of streams, lakes, and ponds.

ANNUAL REPORTS.

Each of the papers contained in the annual reports was also issued in separate form.

Annual reports are distributed free by the Geological Survey as long as its stock lasts. An asterisk (*) indicates that this stock has been exhausted. Many of the papers so marked, however, may be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C.

*Sixth Annual Report of the United States Geological Survey, 1884–85, J. W. Powell, Director. 1885. xxix, 570 pp., 65 pls. Cloth $2.00 Contains:

* Seacost swamps of the eastern United States, by N. S. Shaler. pp. 353–398. Describes the coast swamps of New England; discusses economic problems connected with marine swamps; gives a detailed account of selected areas of salt marsh lands, and a list of the principal areas of salt marshes between the Hudson River and Portland, Maine.

*Tenth Annual Report of the United States Geological Survey, 1888–89, J. W. Powell, Director. 1890. 2 parts. *Pt. I—Geology, xv, 774 pp., 98 pls. Cloth $2.35 Contains:

* General account of the fresh-water morasses of the United States, with a description of the Dismal Swamp district of Virginia and North Carolina, by N. S. Shaler, pp. 255–339, Pls. 6 to 19. Scope indicated by title.

Fourteenth Annual Report of the United States Geological Survey, 1892–93, J. W. Powell, Director. 1893. (Pt. II, 1894.) 2 parts. *Pt. II.—Accompanying papers, xx, 597 pp., 73 pls. Cloth $2.10. Contains:

* The potable waters of the eastern United States, by W. J. McGee, pp. 1 to 47. Discusses cistern water, stream waters, and ground waters, including mineral springs and artesian wells.

364. Water analyses from the laboratory of the United States Geological Survey, tabulated by F. W. Clarke, chief chemist. 1914. 40 pp.

Contains analyses of spring and well waters in Maine, District of Columbia, and Virginia.

PROFESSIONAL PAPERS.

Professional papers are distributed free by the Geological Survey as long as its stock lasts. An asterisk (*) indicates that this stock has been exhausted. Many of the papers marked with an asterisk may, however, be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C. Professional papers are of quarto size.

*44. Underground-water resources of Long Island, N. Y., by A. C. Veatch, C. S. Slitcher, Isaiah Bowman, W. O. Crosby, and R. E. Horton. 1906. 394 pp., 34 pls. $1.25.

Describes the geologic formations, the source of the ground waters, and requsite conditions for flowing wells; the springs, streams, ponds, and lakes; artesian and deep wells; fluctuation of ground-water table; blowing wells; waterworks; discusses measurements of velocity of underflow, the results of sizing and filtration tests, and the utilization of stream waters; gives well records and notes (with chemical analyses) concerning representative wells.

BULLETINS.

An asterisk (*) indicates that the Geological Survey's stock of the paper is exhausted. Many of the papers so marked may be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C.

*138. Artesian well prospects in the Atlantic Coastal Plain region, by N. H. Darton. 1896. 232 pp., 19 pls.

Describes the general geologic structure of the Atlantic Coastal Plain region and summarizes the conditions affecting subterranean water in the Coastal Plain; discusses the general geological relations in New York, southern New Jersey, Delaware, Maryland, District of Columbia, Virginia, North Carolina, South Carolina, and eastern Georgia; gives for each of the States a list of the deep wells and discusses well prospects. The notes on the wells that follows the tabulated lists contain many well sections and analyses of the waters.

*264. Record of deep well drilling for 1904, by M. L. Fuller, E. F. Lines, and A. C. Veatch. 1905. 106 pp. 10c.

Discusses the importance of accurate well records to the driller, to owners of oil, gas, and water wells, and to the geologist; describes the general methods of work; gives tabulated records of wells in Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Virginia, and detailed records of wells at Pleasantville and Atlantic Highlands, N. J., and Tully, N. Y. These wells were selected because they give definite stratigraphic information.

*298. Record of deep well drilling for 1905, by M. L. Fuller and Samuel Sanford, 1906. 299 pp. 25c.

Gives an account of progress in the collection of well records and samples; contains tabulated records of wells in Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and Virginia, and detailed records of wells in Newcastle County, Del.; Cumberland County, Maine; Anne Arundel, St. Mary, and Talbot counties, Md.; Hampshire County, Mass.; Monmouth County, N. J.; Saratoga County, N. Y.; and Lycoming and Somerset counties, Pa. The wells of which detailed sections are given were selected because they afford valuable stratigraphic information.

*531. Contributions to economic geology, 1911, Part II, Mineral fuels; M. R. Campbell, geologist in charge. 1913. 361 pp., 24 pls. 45c.

Issued also in separate chapters. The following papers contain information on ground water: *(d) Geologic structure of the Punxsutawney, Curwensville, Houtzdale, Barnesboro, and Patton quadrangles, central Pennsylvania, by G. H. Ashley, and M. R. Campbell (pp. 69-89, Pls. VII-VIII). Discusses the geologic structure of the five quadrangles named and includes a map showing structure contours. It contains a brief statement in regard to shallow and deep wells and artesian prospects (pp. 88-89). The ground water in the Barnesboro and Patton quadrangles is also briefly described in Geologic Folio 189, and the ground water in these two quadrangles and in the Curwensville quadrangle is briefly described in Water Supply Paper 110.

GEOLOGIC FOLIOS.

Under the plan adopted for the preparation of a geologic map of the United States the entire area is divided into small quadrangles, bounded by certain meridians and parallels, and these quadrangles, which number several thousand, are separately surveyed and mapped.[1] The unit of survey is also the unit of publication, and the

[1] Index maps showing areas in the North Atlantic slope basins covered by topographic maps and by geologic folios will be mailed on receipt of request addressed to the Director, U. S. Geological Survey, Washington, D. C.

maps and description of each quadrangle are issued in the form of a folio. When all the folios are completed they will constitute the Geologic Atlas of the United States.

A folio is designated by the name of the principal town or of a prominent natural feature within the quadrangle. Each folio includes maps showing the topography, geology, underground structure, and mineral deposits of the area mapped and several pages of descriptive text. The text explains the maps and describes the topographic and geologic features of the country and its mineral products. The topographic map shows roads, railroads, waterways, and, by contour lines, the shapes of the hills and valleys and the height above sea level of all points in the quadrangle. The areal-geology map shows the distribution of the various rocks at the surface. The structural-geology map shows the relations of the rocks to one another underground. The economic-geology map indicates the location of mineral deposits that are commercially valuable. The artesian-water maps show the depth to underground-water horizons. Economic-geology and artesian-water maps are included in folios if the conditions in the areas mapped warrant their publication. The folios are of special interest to students of geography and geology and are valuable as guides in the development and utilization of mineral resources.

Folios 1 to 163, inclusive, are published in only one form (18 by 22 inches), called the library edition. Some of the folios that bear numbers higher than 163 are published also in an octavo edition (6 by 9 inches). Owing to a fire in the Geological Survey building May 18, 1913, the stock of geologic folios was more or less damaged by fire and water, but the folios that are usable are sold at the uniform price of 5 cents each, with no reduction for wholesale orders. This rate applies to folios in stock from 1 to 184, inclusive (except reprints), also to the library edition of Folio 186. The library edition of Folios 185, 187, and higher numbers sells for 25 cents a copy, except that some folios which contain an unusually large amount of matter sell at higher prices. The octavo edition of Folio 185 and higher numbers sells for 50 cents a copy, except Folio 193, which sells for 75 cents a copy. A discount of 40 per cent is allowed on an order for folios, or for folios together with topographic maps, amounting to $5, or more at the retail rate.

All the folios contain descriptions of the drainage of the quadrangles. The folios in the following list contain also brief discussions of the underground waters in connection with the economic resources of the areas and more or less information concerning the utilization of the water resources.

An asterisk (*) indicates that the stock of the folio is exhausted.

*13. Fredericksburg, Virginia-Maryland. 1894. 5c.

23. Nomini, Maryland-Virginia. 1896. 5c.

*70. Washington, District of Columbia-Maryland-Virginia. 1901.

*83. New York City (Paterson, Harlem, Staten Island, and Brooklyn quadrangles), New York-New Jersey. 1902.

Discusses the present and future water supply of New York City.

136. St. Marys, Maryland-Virginia. 1906. 5c.

Discusses artesian wells.

*137. Dover, Delaware-Maryland-New Jersey. 1906. 5c.

Describes the shallow and deep wells used as sources of water suppy; gives section of well at Middletown, Del.

*149. Penobscot Bay, Maine. 1907. 5c.

Describes the wells and springs; gives analysis of spring water from North Bluehill.

152. Patuxent, Maryland-District of Columbia. 1907. 5c.

Discusses the springs, shallow wells, and artesian wells.

*157. Passaic, New Jersey-New York. 1908.

Discusses the underground water of the quadrangle, including the cities of Newark, Hoboken, Jersey City, Paterson, Elizabeth, Passaic, Plainfield, Rahway, and Perth Amboy, and a portion of the City of New York; gives a list of the deep borings in the New Jersey portion of the quadrangle, and notes concerning wells on Staten Island, Long Island, Hoffman Island, and Governors Island.

158. Rockland, Maine. 1908. 5c.

Describes the water supply in Knox County, Maine, of which Rockland is the principal city; discusses the water obtained from wells drilled in limestone and granite, and the city water supply of Camden, Rockport, Rockland, and Thomaston.

*160. Accident-Grantville, Maryland-Pennsylvania-West Virginia. 1908. 5c.

Under "Mineral Resources" the folio describes Youghiogheny and Castleman rivers, Savage River, and Georges Creek, and the spring waters; notes possibility of obtaining artesian water.

*161. Franklin Furnace, New Jersey. 1908.

Describes the streams, water powers, and ground waters of a district in northwestern New Jersey, mainly in Sussex County but including also a small part of Morris County; gives tabulated list of water powers and of bored wells.

*162. Philadelphia (Norristown, Germantown, Chester, and Philadelphia quadrangles), Pennsylvania-New Jersey-Delaware. 1909.

Discusses the water supply of Philadelphia and Camden, also suburban towns; gives analysis of filtered water of Pickering Creek.

*167. Trenton, New Jersey-Pennsylvania.[1] 1909. 5c.

Describes streams tributary to Raritan and Delaware rivers (including estimates of capacity with and without storage) and the springs and wells; discusses also the public water supply of Trenton and suburban towns.

*169. Watkins Glen-Catatonk, New York. 1909. 5c.

Describes springs and shallow and deep wells; discusses also water supply at Ithaca.

170. Mercersburg-Chambersburg, Pennsylvania.[2] 1909. 5c.

Describes springs and wells and mentions sources of water supplies of principal towns.

179. Pawpaw-Hancock, West Virginia-Maryland-Pennsylvania. 1912. 5c.

Gives analysis of water of Berkeley Springs.

182. Choptank, Maryland. 1912.[2] 5c.

The Choptank quadrangle includes the entire width of Chesapeake Bay and portions of many large estuaries.

189. Barnesboro-Patton, Pennsylvania. 1913. 25c.

Discusses the water supply of various towns in the quadrangle.

191. Raritan, New Jersey.[3] 1914.

Discusses briefly the surface and ground waters of the quadrangle, the quality, and the utilization of streams for power; gives analysis of water from Raritan River and from Schooley Mountain Spring near Hackettstown.

192. Eastport, Maine. 1914. 25c.

Includes brief account of the water supply of the quadrangle and of the utilization of streams for power.

204. Tolchester, Maryland. 1917. 25c.

Discusses shallow and artesian wells.

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[1] Octavo edition only.

[2] Issued in two editions—library (18 by 22 inches) and octavo (6 by 9 inches). Specify edition desired.

MISCELLANEOUS REPORTS.

Other Federal bureaus and State and other organizations have from time to time published reports relating to the water resources of various sections of the country. Notable among those pertaining to the North Atlantic States are the reports of the Main State Water Storage Commission (Augusta), the New Hampshire Forestry Commission (Concord), the Metropolitan Water and Sewerage Board (Boston, Mass.), the New York State Water-Supply Commission (Albany), the New York State Conservation Commission (Albany), the New York State engineer and surveyor (Albany), the various commissions on water supply of New York City, the Geological Survey of New Jersey (Trenton), State boards of health, and the Tenth Census (vol. 16).

The following reports deserve special mention:

Water power of Maine, by Walter Wells, Augusta, 1869.

Hydrology of the State of New York, by G. W. Rafter: New York State Museum Bull. 85, 1905.

Hydrography of Virginia, by N. C. Grover and R. H. Bolster: Virginia Geol. Survey Bull. 3, 1906.

Underground-water resources of the Coastal Plain province of Virginia, by Samuel Stanford: Virginia Geol. Survey Bull. 5, 1913.

Surface water supply of Virginia, by G. C. Stevens: Virginia Geol. Survey Bull. 19, 1916.

Many of these reports can be obtained by applying to the several commissions, and most of them can be consulted in the public libraries of the larger cities.

GEOLOGICAL SURVEY HYDROLOGIC REPORTS OF GENERAL INTEREST.

The following list comprises reports that are not readily classifiable by drainage basins and that cover a wide range of hydrologic investigations:

WATER-SUPPLY PAPERS.

*1. Pumping water for irrigation, by H. M. Wilson. 1896. 57 pp., 9 pls.
Describes pumps and motive powers, windmills, water wheels, and various kinds of engines; also storage reservoirs to retain pumped water until needed for irrigation.

*3. Sewage irrigation, by G. W. Rafter. 1897. 100 pp., 4 pls. 10c. (See Water-Supply Paper 22.)
Discusses methods of sewage disposal by intermittent filtration and by irrigation; describes utilization of sewage in Germany, England, and France, and sewage purification in the United States.

*8. Windmills for irrigation, by E. C. Murphy. 1897. 49 pp., 8 pls. 10c.
Gives results of experimental tests of windmills during the summer of 1896 in the vicinity of Garden, Kans.; describes instruments and methods and draws conclusions.

*14. New tests of certain pumps and water lifts used in irrigation, by O. P. Hood. 1898. 91 pp., 1 pl. 10c.
Discusses efficiency of pumps and water lifts of various types.

*20. Experiments with windmills, by T. O. Perry. 1899. 97 pp., 12 pls. 15c.
Includes tables and descriptions of wind wheels, compares wheels of several types, and discusses results.

*22. Sewage irrigation, Part II, by G. W. Rafter. 1899. 100 pp., 7 pls. 15c.
Gives résumé of Water-Supply Paper No. 3; discusses pollution of certain streams, experiments on purification of factory wastes in Massachusetts, value of commercial fertilizers, and describes American sewage-disposal plants by States; contains bibliography of publications relating to sewage utilization and disposal.

*41. The windmill: Its efficiency and economic use, Part I, by E. C. Murphy. 1901. 72 pp., 14 pls.

*42. The windmill: Its efficiency and economic use, Part II, by E. C. Murphy. 1901. 75 pp., 2 pls. 10c.
Nos. 41 and 42 give details of results of experimental tests with windmills of various types.

*43. Conveyance of water in irrigation canals, flumes, and pipes, by Samuel Fortier. 1901. 86 pp., 15 pls. 15c.

*56. Methods of stream measurement. 1901. 51 pp., 12 pls. 15c.
Describes the methods used by the Survey in 1901-2. See also Nos. 64, 94, and 95.

*64. Accuracy of stream measurements, by E. C. Murphy. 1902. 99 pp., 4 pls. (See No. 95.) 10c.
Describes methods of measuring velocity of water and of measuring and computing stream flow and compares results obtained with the different instruments and methods; describes also experiment and results at the Cornell University hydraulic laboratory. A second, enlarged edition published as Water-Supply Paper 95.

*67. The motions of underground waters, by C. S. Slichter. 1902. 106 pp., 8 pls. 15c.
Discusses origin, depth, and amount of underground waters; permeability of rocks and porosity of soils; causes, rates, and laws of motions of underground water; surface and deep zones of flow, and recovery of waters by open wells and artesian and deep wells; treats of the shape and position of the water table; gives simple methods of measuring yield of flowing wells; describes artesian wells at Savannah, Ga.

*80. The relation of rainfall to run-off, by G. W. Rafter. 1903. 104 pp. 10c.
Treats of measurements of rainfall and laws and measurements of stream flow; gives rainfall run-off, and evaporation formulas; discusses effect of forests on rainfall and run-off.

87. Irrigation in India (second edition), by H. M. Wilson. 1903. 238 pp., 27 pls. 25c.
First edition was published in Part II of the Twelfth Annual Report.

93. Proceedings of first conference of engineers of the Reclamation Service, with accompanying papers, compiled by F. H. Newell, chief engineer. 1904. 361 pp. 25c. [Requests for this report should be addressed to the U. S. Reclamation Service.]
Contains the following papers of more or less general interest:
Limits of an irrigation project, by D. W. Ross.
Relation of Federal and State laws to irrigation, by Morris Bien.
Electrical transmission of power for pumping, by H. A. Storrs.
Correct design and stability of high masonry dams, by Geo. Y. Wisner.
Irrigation surveys and the use of the plane table, by J. B. Lippincott.
The use of alkaline waters for irrigation, by Thomas H. Means.

*94. Hydrographic manual of the United States Geological Survey, prepared by E. C. Murphy, J. C. Hoyt, and G. B. Hollister. 1904. 76 pp., 3 pls. 10c.
Gives instruction for field and office work relating to measurements of stream flow by current meters. See also No. 95.

*95. Accuracy of stream measurements (second enlarged edition), by E. C. Murphy. 1904. 169 pp., 6 pls.
Describes methods of measuring and computing stream flow and compares results derived from different instruments and methods. See also No. 94.

*103. A review of the laws forbidding pollution of inland waters in the Unites States, by E. B. Goodell. 1940. 120 pp. (See No. 152.)
Explains the legal principles under which antipollution statutes become operative, quotes court decisions to show authority for various deductions, and classifies according to scope the statutes enacted in the different States.

110. Contributions to the hydrology of eastern United States, 1904; M. L. Fuller, geologist in charge. 1905. 211 pp., 5 pls. 10c.
Contains the following reports of general interest. The scope of each paper is indicated by its title.
Description of underflow meter used in measuring the velocity and direction of underground water, by Charles S. Slichter.
The California or "stovepipe" method of well construction, by Charles S. Slichter.
Approximate methods of measuring the yield of flowing wells, by Charles S. Slichter.
Corrections necessary in accurate determinations of flow from vertical well casings, from notes furnished by A. N. Talbot.
Experiments relating to problems of well contamination as Quitman, Ga., by S. W. McCallie.

113. The disposal of strawboard and oil-well wastes, by R. L. Sackett and Isaiah Bowman. 1905. 52 pp., 4 pls. 5c.
The first paper discusses the pollution of streams by sewage and by trade wastes, descripes the manufacture of strawboard, and gives results of various experiments in disposing of the waste. The second paper describes briefly the topography, drainage, and geology of the region about Marion, Ind., and the contamination of rock wells and of streams by waste oil and brine.

*114. Underground waters of eastern United States; M. L. Fuller, geologist in charge. 1905. 285 pp., 18 pls. 25c.
Contains report on "Occurrence to underground waters," by M. L. Fuller, discussing sources, amount, and temperature of waters, permeability and storage capacity of stocks, water-bearing formations, recovery of water by springs, well, and pumps, essential condition of artesian flows and general conditions affecting underground waters in eastern United States.

115. River surveys and profiles made during 1903, arranged by W. C. Hall and J. C. Hoyt. 1905. 115 pp., 4 pls. 10c.
Contains results of survey made to determine location of undeveloped power sites.

119. Index to the hydrographic progress reports of the United States Geological Survey, 1888 to 1903, by J. C. Hoyt and B. D. Wood. 1905. 253 pp. 15c.
Scope indicated by title.

120. Bibliographic review and index of papers relating to underground waters published by the United States Geological Survey, 1879–1904, by M. L. Fuller. 1905. 128 pp. 10c.

Scope indicated by title.

*122. Relation of the law to underground waters, by D. W. Johnson. 1905. 55 pp. 5c.

Defines and classifies underground waters, gives common-law rules relating to their use, and cites State legislative acts affecting them.

140. Field measurements of the rate of movement of underground waters, by C. S. Slichter. 1905. 122 pp., 15 pls. 15c.

Discusses the capacity of sand to transmit water, describes measurements of underflow in Rio Hondo, San Gabriel, and Mohave River valleys, Calif., and on Long Island, N. Y.; gives results of tests of wells and pumping plants, and describes stovepipe method of well construction.

143. Experiments on steel-concrete pipes on a working scale, by J. H. Quinton. 1905. 61 pp., 4 pls.

Scope indicated by title.

145. Contributions to the hydrology of eastern United States, 1905; M. L. Fuller, geologist in charge. 1905. 220 pp., 6 pls. 10c.

Contains brief reports of general interest as follows:

Drainage of ponds into drilled wells, by Robert E. Horton. Discusses efficiency, cost, and capacity of drainage wells, and gives statistics of such wells in southern Michigan.

Construction of so-called fountain and geyser springs, by Myron L. Fuller.

A convenient gage for determining low artesian heads, by Myron L. Fuller.

146. Proceedings of second conference of engineers of the Reclamation Service, with accompanying papers, compiled by F. H. Newell, chief engineer. 1905. 267 pp. 15c.

Contains brief account of the organization of the hydrographic [water-resources] branch and the Reclamation Service, reports of conferences and committees, circulars of instruction, and many brief reports on subjects closely related to reclamation, and a bibliography of technical papers by members of the service. Of the papers read at the conference those listed below (scope indicated by title) are of more or less general interest:

Proposed State code of water laws, by Morris Bien.
Power engineering applied to irrigation problems, by O. H. Ensign.
Estimates on tunneling in irrigation projects, by A. L. Fellows.
Collection of stream-gaging data, by N. C. Grover.
Diamond-drill methods, by G. A. Hammond.
Mean-velocity and area curves, by F. W. Hanna.
Importance of general hydrographic data concerning basins of streams gaged, by R. E. Horton.
Effect of aquatic vegetation on stream flow, by R. E. Horton.
Sanitary regulations governing construction camps, by M. O. Leighton.
Necessity of draining irrigated land, by Thos. H. Means.
Alkali soils, by Thos. H. Means.
Cost of stream-gaging work, by E. C. Murphy.
Equipment of a cable gaging station, by E. C. Murphy.
Silting of reservoirs, by W. M. Reed.
Farm-unit classification, by D. W. Ross.
Cost of power for pumping irrigating water, by H. A. Storrs.
Records of flow at current-meter gaging stations during the frozen season, by F. H. Tillinghast.

147. Destructive floods in United States in 1904, by E. C. Murphy and others. 206 pp., 18 pls. 15c.

Contains a brief account of "A method of computing cross-section area of waterways," including formulas for maximum discharge and area of cross section.

*150. Weir experiments, coefficients, and formulas, by R. E. Horton. 1906. 189 pp., 38 pls. (See Water-Supply Paper 200.) 15c.

Scope indicated by title.

151. Field assay of water, by M. O. Leighton. 1905. 77 pp., 4 pls. 10c.

Discusses methods, instruments, and reagents used in determining turbidity, color, iron, chlorides, and hardness, in connection with studies of the quality of water in various parts of the United States.

*152. A review of the laws forbidding pollution of inland waters in the United States (second edition), by E. B. Goodell. 1905. 149 pp. 10c.
Scope indicated by title.

*160. Underground-water papers, 1906; M. L. Fuller, geologist in charge. 1906. 104 pp., 1 pl.
Gives account of work in 1905, lists of publications relating to underground waters, and contains the following brief reports of general interest:
Significance of the term "artesian," by Myron L. Fuller.
Representation of wells and springs on maps, by Myron L. Fuller.
Total amount of free water in the earth's crust, by Myron L. Fuller.
Use of fluorescein in the study of underground waters, by R. B. Dole.
Problems of water contamination, by Isaiah Bowman.
Instances of improvement of water in wells, by Myron L. Fuller.

*162. Destructive floods in the United States in 1905, with a discussion of flood discharge and frequency and an index to flood literature, by E. C. Murphy and others. 1906. 105 pp., 4 pls. 15c.

*163. Bibliographic review and index of underground-water literature published in the United States in 1905, by M. L. Fuller, F. G. Clapp, and B. L. Johnson. 1906. 130 pp. 15c.
Scope indicated by title.

*179. Prevention of stream pollution by distillery refuse, based on investigations at Lynchburg, Ohio, by Herman Stabler. 1906. 34 pp., 1 pl. 10c.
Describes grain distillation, treatment of slop, sources, character, and effects of effluent on streams; discusses filtration, precipitation, fermentation, and evaporation methods of disposal of wastes without pollution.

*180. Turbine water-wheel tests and power tables, by R. E. Horton. 1906. 134 pp. 2 pls. 20c.
Scope indicated by title.

*186. Stream pollution by acid-iron wastes, a report based on investigations made at Shelby, Ohio, by Herman Stabler. 1906. 36 pp., 1 pl.
Gives history of pollution by acid-iron wastes at Shelby, Ohio, and resulting litigation; discusses effect of acid-iron liquors on sewage purification processes, recovery of copperas from acid-iron wastes, and other processes for disposal of pickling liquor.

*187. Determination of stream flow during the frozen season, by H. K. Barrows and R. E. Horton. 1907. 93 pp., 1 pl. 15c.
Scope indicated by title.

*189. The prevention of stream pollution by strawboard waste, by E. B. Phelps. 1906. 29 pp., 2 pls. 5c.
Describes manufacture of strawboard, present and proposed methods of disposal of waste liquors, laboratory investigations of precipitation and sedimentation, and field studies of amounts and character of water used, raw material and finished product, and mechanical filtration.

*194. Pollution of Illinois and Mississippi rivers by Chicago sewage (a digest of the testimony taken in the case of the State of Missouri *v.* the State of Illinois and the Sanitary district of Chicago), by M. O. Leighton. 1907. 369 pp., 2 pls. 40c.
Scope indicated by amplification of title.

*200. Weir experiments, coefficients, and formulas (revision of paper No. 150), by R. E. Horton. 1907. 195 pp., 38 pls. 35c.
Scope indicated by title.

*226. The pollution of streams by sulphite pulp waste, a study of possible remedies, by E. B. Phelps. 1909. 37 pp., 1 pl. 10c.
Describes manufacture of sulphite pulp, the waste liquors, and the experimental work leading to suggestions as to methods of preventing stream pollution.

*229. The disinfection of sewage and sewage filter effluents, with a chapter on the putrescibility and stability of sewage effluents, by E. B. Phelps. 1909. 91 pp., 1 pl. 15c.
Scope indicated by title.

*234. Papers on the conservation of water resources. 1909. 96 pp., 2 pls. 15c.
Contains the following papers, whose scope is indicated by their titles: Distribution of rainfall, by Henry Gannett; Floods, by M. O. Leighton; Developed water powers, compiled under the direction of W. M. Steuart, with discussion by M. O. Leighton; Undeveloped water powers by M. O. Leighton; Irrigation, by F. H. Newell; Underground waters, by W. C. Mendenhall, Denudation, by R. B. Dole and Herman Stabler; Control of catchment areas, by H. N. Parker

*235. The purification of some textile and other factory wastes, by Herman Stabler and G. H. Pratt. 1909. 76 pp. 10c.
Discusses waste waters from wool scouring, bleaching and dyeing cotton yarn, bleaching cotton piece goods. and manufacture of oleomargine, fertilizer, and glue.

236. The quality of surface waters in the United States, Part I.—Analyses of waters east of the one hundredth meridian, by R. B. Dole. 1909. 123 pp. 10c.
Describes collection of samples, methods of examination, preparation of solutions, accuracy of estimates, and expression of analytical results.

238. The public utility of water powers and their governmental regulation, by René Tavernier and M. O. Leighton. 1910. 161 pp. 15c.
Discusses hydraulic power and irrigation, French, Italian, and Swiss legislation relative to the development of water powers, and laws proposed in the French parliament; reviews work of bureau of hydraulics and agricultural improvement of the French department of agriculture, and gives résumé of Federal and State water-power legislation in the United States.

*255. Underground waters for farm use, by M. L. Fuller. 1910. 58 pp., 17 pls. 15c.
Discusses rocks as sources of water supply and the relative safety of supplies from different materials; springs and their protection; open or dug and deep wells, their location, yield, relative cost, protection, and safety; advantages and disadvantages of cisterns and combination wells and cisterns.

*257. Well-drilling methods, by Isaiah Bowman. 1911. 139 pp., 4 pls. 15c.
Discusses amount, distribution, and disposal of rainfall, water-bearing rocks, amount of underground water and artesian conditions, and oil and gas bearing formations; gives history of well drilling in Asia, Europe, and the United States; describes in detail the various method and the machinery used; discusses loss of tools and geologic difficulties; contamination of well waters and methods of prevention; tests of capacity and measurement of depth; and costs of sinking wells.

*258. Underground-water papers, 1910, by M. L. Fuller, F. G. Clapp, G. C. Matson, Samuel Sanford, and C. H. Wolff. 1911. 123 pp., 2 pls. 15c.
Contains the following papers (scope indicated by titles) of general interest:
Drainage by wells, by M. L. Fuller.
Freezing of wells and related phenomena, by M. L. Fuller.
Pollution of underground waters in limestone, by G. C. Matson.
Protection of shallow wells in sandy deposits, by M. L. Fuller.
Magnetic wells, by M. L. Fuller.

259. The underground waters of southwestern Ohio, by M. L. Fuller and F. G. Clapp, with a discussion of the chemical character of the waters, by R. B. Dole. 1912. 228 pp., 9 pls. 35c.
Describes the topography, climate, and geology of the region, the water-bearing formations the source, mode of occurrence, and head of the waters, and municipal supplies; gives details by counties; discusses in supplement, under chemical character, method of analysis and expression of results, mineral constituents, effect of the constituents on waters for domestic, industrial, or medicinal uses, methods of purification, and chemical composition; many analyses and field assays. The matter in the supplement was also published in Water-Supply Paper 254 (The underground waters of north-central Indiana).

274. Some stream waters of the western United States, with chapters on sediment carried by the Rio Grande and the industrial application of water analyses, by Herman Stabler. 1911. 188 pp. 15c.
Describes collection of samples, plan of analytical work, and methods of analyses; discusses soap-consuming power of waters, water softening, boiler waters, and water for irrigation.

280. Gaging stations maintained by the United States Geological Survey, 1888-1910, and Survey publications relating to water resources, compiled by B. D. Wood. 1912. 102 pp. 10c.

*315. The purification of public water supplies, by G. A. Johnson. 1913. 84 pp., 8 pls. 10c.

Discusses ground, lake, and river waters as public supplies, development of waterworks systems in the United States, water consumption, and typhoid fever; describes methods of filtration and sterilization of water and municipal water softening.

334. The Ohio Valley flood of March–April, 1913 (including comparisons with some earlier floods), by A. H. Horton and H. J. Jackson. 1913. 96 pp., 22 pls. 20c.

Although relating specifically to floods in the Ohio Valley, this report discusses also the causes of floods and the prevention of damage by floods.

337. The effects of ice on stream flow, by William Glenn Hoyt. 1913. 77 pp., 7 pls. 15c.

Discusses methods of measuring the winter flow of streams.

*345. Contributions to the hydrology of the United States, 1914. N. C. Grover, chief hydraulic engineer. 1915. 225 pp., 17 pls. 30c. Contains:

*(e) A method of determining the daily discharge of rivers of various slope, by M. R. Hall W. E. Hall, and C. H. Pierce, pp. 53–65. 5c. Scope indicated by title.

364. Water analyses from the laboratory of the United States Geological Survey, tabulated by F. W. Clarke, chief chemist. 1914. 40 pp. 5c.

Contains analyses of waters from rivers, lakes, wells, and springs in various parts of the United States, including analyses of the geyser water of Yellowstone National Park, hot springs in Montana, brines from Death Valley, water from the Gulf of Mexico, and mine waters from Tennessee, Michigan, Missouri and Oklahoma, Montana, Colorado and Utah, Nevada and Arizona, and California.

371. Equipment for current-meter gaging stations, by G. J. Lyon. 1915. 64 pp., 37 pls. 20c.

Describes methods of installing recording and other gages and of constructung gage wells shelters, and structures for making discharge measurements and artificial controls.

*375. Contributions to the hydrology of the United States, 1915. N. C. Grover, chief hydraulic engineer. 1916. 181 pp., 9 pls. Contains:

(c) Relation of stream gaging to the science of hydraulics, by C. H. Pierce and R. W. Davenport, pp. 77–84.

(e) A method for correcting river discharge for changing stage, by B. E. Jones, pp. 117–130.

(f) Conditions requiring the use of automatic gages in obtaining stream-flow records, by C. H. Pierce, pp. 131–139.

*400. Contributions to the hydrology of the United States, 1916. N. C. Grover, chief hydraulic engineer. Contains:

(a) The people's interest in water-power resources, by G. O. Smith, pp. 1–8.

(c) The measurement of silt-laden streams, by Raymond C. Pierce, pp. 39–51.

(d) Accuracy of stream-flow data, by N. C. Grover and J. C. Hoyt, pp. 53–59.

416. The divining rod, a history of water witching, with a bibliography, by Arthur J. Ellis. 1917. 39 pp. 10c.

A brief paper published "merely to furnish a reply to the numerous inquiries that are continually being received from all parts of the country" as to the efficacy of the divining rod for locating underground water.

425. Contributions to the hydrology of the United States, 1917, N. C. Grover, chief hydraulic engineer. 1918. Contains:

(c) Hydraulic conversion tables and convenient equivalents, pp. 71–94. 1917.

427. Bibliography and index of the publications of the United States Geological Survey relating to ground water, by O. E. Meinzer. 1918. 169 pp., 1 pl.

Includes publications prepared, in whole or part, by the Geological Survey that treat any phase of the subject of ground water or any subject directly applicable to ground water. Illustrated by map showing reports that cover specific areas more or less thoroughly.

PROFESSIONAL PAPERS.

*72. Denudation and erosion in the southern Appalachian region and the Monongahela basin, by L. C. Glenn. 1911. 137 pp., 21 pls. 35c.

Describes the topography, geology, drainage, forests, climate, population, and transportation facilities of the region, the relation of agriculture, lumbering, mining, and power development to erosion and denudation, and the nature, effects, and remedies of erosion; gives details of conditions in Holston, Nolichucky, French Broad, Little Tennessee, and Hiwassee river basins, along Tennessee River proper, and in the basins of the Coosa-Alabama system, Chattahoochee, Savannah, Saluda, Broad, Catawba, Yadkin, New, and Monongahela rivers.

86. The transportation of débris by running water, by G. K. Gilbert, based on experiments made with the assistance of E. C. Murphy. 1914. 263 pp., 3 pls. 70c.

The results of an investigation which was carried on in a specially equipped laboratory at Berkeley, Calif., and was undertaken for the purpose of learning "the laws which control the movement of bed load and especially to determine how the quantity of load is related to the stream's slope and discharge and to the degree of comminution of the débris."

A highly technical report.

105. Hydraulic mining débris in the Sierra Nevada, by G. K. Gilbert. 154 pp., 34 pls. 1917.

Presents the results of an investigation undertaken by the United States Geological Survey in response to a memorial from the California Miners' Association asking that a particular study be made of portions of the Sacramento and San Joaquin valleys affected by detritus from torrential streams. The report deals largely with geologic and physiographic aspects of the subject, traces the physical effects, past and future, of the hydraulic mining of earlier decades, the similar effects which certain other industries induce through stimulation of the erosion of the soil, and the influence of the restriction of the areas of inundation by the construction of levees. Suggests cooperation by several interests for the control of the streams now carrying heavy loads of débris.

BULLETINS.

*32. Lists and analyses of the mineral springs of the United States (a preliminary study), by A. C. Peale. 1886. 235 pp.

Defines mineral waters, lists the springs by States, and gives tables of analyses so far as available.

*264. Record of deep-well drilling for 1904, by M. L. Fuller, E. F. Lines, and A. C. Veatch. 1905. 106 pp. 10c.

*298. Record of deep-well drilling for 1905, by M. L. Fuller and Samuel Sanford. 1906. 299 pp. 25c.

Bulletins 264 and 298 discuss the importance of accurate well records to the driller, to owners of oil, gas, and water wells, and to the geologist; describes the general methods of work; gives tabulated records of wells by States, and detailed records selected as affording valuable stratigraphic information.

*319. Summary of the controlling factors of artesian flows, by Myron L. Fuller. 1908. 44 pp., 7 pls. 10c.

Describes underground reservoirs, the sources of underground waters, the confining agents, the primary and modifying factors of artesian circulation, the essential and modifying factors of artisian flow, and typical artisian systems.

*479. The geochemical interpretation of water analyses, by Chase Palmer. 1911. 31 pp. 5c.

Discusses the expression of chemical analyses, the chemical character of water, and the properties of natural waters; gives a classification of waters based on property values and reacting values, and discusses the character of the waters of certain rivers as interpreted directly from the results of analyses; discusses also the relation of water properties to geologic formations, silica in river water, and the character of the water of the Mississippi and the Great Lakes and St. Lawrence River as indicated by chemical analyses.

616. The data of geochemistry (third edition), by F. W. Clarke. 1916. 821 pp. 45c.

Earlier editions were published as Bulletins 330 and 491. Contains a discussion of the statement and terpretation of water analyses and a chapter on "Mineral wells and springs" (pp. 179-216). Discusses the definition and classification of mineral waters, changes in the composition of water, deposits of calcareous, ocherous and siliceous materials made by water, vadose and juvenile waters, and thermal springs in relation to volcanism. Describes the different kinds of ground water and gives typical analyses. Includes a brief bibliography of papers containing water analyses.

ANNUAL REPORTS.

*Fifth Annual Report of the United States Geological Survey, 1883–84, J. W. Powell, Director. 1885. xxxvi, 469 pp., 58 pls. $2.25. Contains:

*The requisite and qualifying conditions of artesian wells, by T. C. Chamberlain, pp. 125 to 173, Pl. 21. Scope indicated by title.

*Twelfth Annual Report of the United States Geological Survey, 1890–91, J.W. Powell, Director. 1891. 2 parts. Pt. II—Irrigation, xviii, 576 pp., 93 pls. $2. Contains:

*Irrigation in India, by H. M. Wilson, pp. 363-561, Pls. 107 to 146. See Water-Supply Paper 87.

Thirteenth Annual Report of the United States Geological Survey, 1891–92, J. W. Powell, Director. 1892. (Pts. II and III, 1893.) 3 parts. *Pt. III—Irrigation, xi, 486 pp., 77 pls. $1.85. Contains:

*American irrigation engineering, by H. M. Wilson, C. E., pp. 101–349, Pls. 111 to 146. Discusses the economic aspects of irrigation, alkaline drainage, silt, and sedimentation; gives brief history and legislation; describes canals; discusses water storage at reservoirs of the California and other projects, subsurface sources of supply, pumping, and subirrigation.

Fourteenth Annual Report of the United States Geological Survey, 1892–93, J. W. Powell, Director. 1893. (Pt. II, 1894). 2 parts. *Pt. II—Accompanying papers, xx, 597 pp., 73 pls. $2.10. Contains:

*The potable waters of the eastern United States, by W J McGee, pp. 1 to 47. Discusses cistern water, stream waters, and ground waters, including mineral springs and artesian wells.

*Natural mineral waters of the United States, by A. C. Peale, pp. 49–88, Pls. 3 and 4. Discusses the origin and flow of mineral springs, the source of mineralization, thermal springs, the chemical composition and analysis of spring waters, geographic distribution, and the utilization of mineral waters; gives a list of American mineral spring resorts; contains also some analyses.

Nineteenth Annual Report of the United States Geological Survey, 1897–98, Charles D. Walcott, Director. 1898. (Parts II, III, and V, 1899.) 6 parts in 7 vols. and separate case for maps with Pt. V. *Pt. II—Papers chiefly of a theoretic nature, v. 958 pp., 172 pls. $2.65. Contains:

*Principles and conditions of the movements of ground water, by F. H. King, pp. 59–294, Pls. 6 to 16. Discusses the amount of water stored in sandstone, in soil, and in other rocks; the depth to which ground water penetrates; gravitational, thermal, and capillary movements of ground waters, and the configuration of the ground-water surface; gives the results of experimental investigations on the flow of air and water through rigid porous media and through sands, sandstones, and silts; discusses results obtained by other investigators, and summarizes results of observations; discusses also rate of flow of water through sand and rock, the growth of rivers, rate of filteration through soil, interference of wells, etc.

*Theoretical investigation of the motion of ground waters, by C. S. Slichter, pp. 295–384, Pl. 17. Scope indicated by title.

INDEX BY AREAS AND SUBJECTS.

[A—Annual Reports; M—Monograph; B—Bulletin; P—Professional Paper; W—Water-Supply Paper; GF—Geologic folio. For titles see preceding pages.]

[1] Many of the reports contain brief subject bibliographies. See abstracts.
[2] Many analyses of river, spring, and well waters are scattered through publications, as noted in abstracts.

INDEX OF STREAMS.

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